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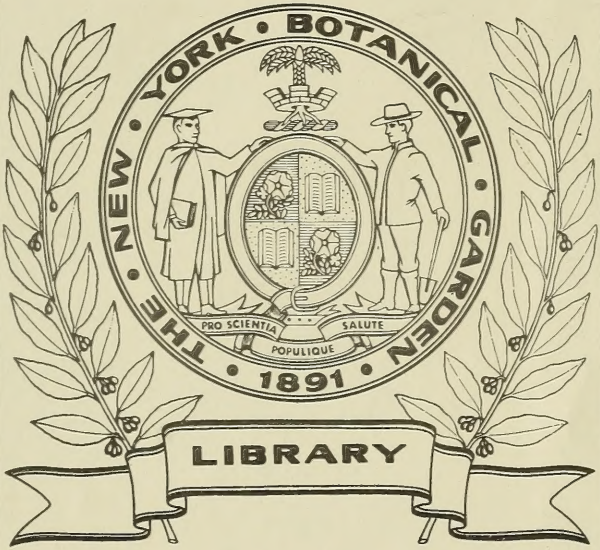
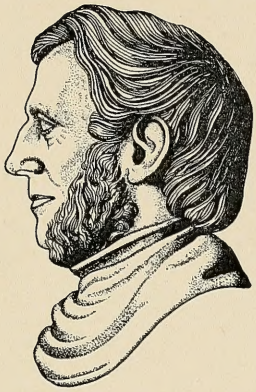


TORREYA

A Quarterly Journal of Botanical Notes and News



John Torrey, 1796-1873

EDITED FOR

THE TORREY BOTANICAL CLUB

BY

HAROLD H. CLUM

VOLUME 44

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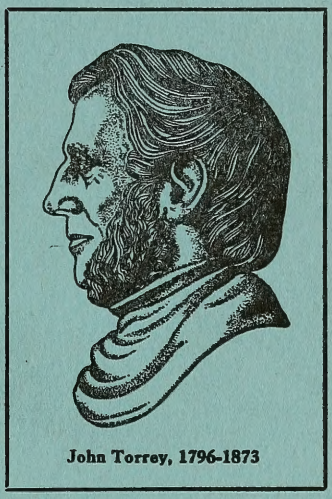

John Torrey, 1796-1873

CONTENTS

Growing Cinchona under American Control.....Colonel Arthur F. Fischer, G.S.C. 1

On the Concept of Type.....Alfred Rehder 6

Improved Rooting of Cryptostegia Cuttings Callused on the Plant.....H. F. Loomis and J. H. Heuer 8

Proceedings of the Club..... 12

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TORREYA

TORREYA was established in 1901 as a monthly publication of the **Torrey Botanical Club** for shorter papers and interesting notes on the local flora range of the Club. It also contains the proceedings of the Club, reports of field trips, and some book reviews and news notes. Volume 43, published last year in two numbers, contained the papers presented at the 75th Anniversary Celebration of the Club in June 1942, and an account of the Activities of the Club during 1943. For the year 1944 TORREYA will resume its former function, but will be published in only four numbers.

The editor invites contributions for future numbers of TORREYA. These should be typed with double spacing on one side of standard paper. Illustrations should be mounted on stiff cardboard, with the desired reductions plainly indicated, and so designed as to fill the full width of the page (4⅝ inches) and any portion of the height (7⅛ inches). Legends for illustrations should be typed and included with the manuscript (*not* affixed to the figures).

The subscription price of TORREYA in the United States and Canada is $1.00 a year, for subscribers elsewhere, 25c extra; single copies, 40c. Of the annual membership dues of the **Torrey Botanical Club,** $0.50 is for a year's subscription to TORREYA.

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Manuscripts for publication, books for review, reports of field trips, and news items should be addressed to:

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HUNTER COLLEGE, 695 PARK AVENUE
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TORREYA

VOL. 44 APRIL 1944 NO. 1

Growing Cinchona under American Control*

COLONEL ARTHUR F. FISCHER, G.S.C.

In talking with Dr. Bonisteel, your former editor of TORREYA, I asked him what he thought I should stress before the Club and he replied, "Go after the dependence of our country on tropical economic plants for the sinews of our industry."

Cinchona is, of course, an outstanding example. In World War I, we were dependent on the Dutch, and Mr. Herbert Hoover, then food administrator, cabled to the Philippines to raise quinine. The Forestry Bureau had a few trees of *C. succirubra* of rather low alkaloid content growing, and efforts were made to obtain seed from Java and India. The seed from India was good seed, but not of the high yielding variety, *Ledgeriana,* and the seed from Java did not grow. However, we did learn a little about the idiosyncrasies of the genus and when General Leonard Wood was appointed Governor General, he made funds available to purchase seed from Java which were obtained for us by Consul General Hoover in Batavia, and from this seed a definite start was made in the plantation industry.

It may be of interest to you to hear how we proceeded. The first criterion laid down was that we had to bring costs down to a competitive level with Java with much higher labor costs in the Philippines. We had therefore to devise and develop field methods which reduced labor to a minimum and increased alkaloid content to a maximum. Terracing was too costly except for nursery beds, and therefore out in plantations. Drainage and soil, and particularly aeration of soil, became the primary basis for the plantation site selections in regions of sufficient rainfall and elevation. Plantings were therefore made on contours.

Forests with good forest soil and thick humus were desired for plantations. They were opened up sufficiently around planting holes to admit one-fourth to one-third light, and as the plants took hold and grew, brushing out every month or two took place admitting more light gradually. Then, in order not to injure quinine trees, felling of timber was not practiced, but girdling and letting trees die standing until a cover was developed by the quinine. We learned this from sad experience of a three-month drought. The practice also prevented erosion from taking place during the rains in the early stages. Whenever we found forest cover inadequate or insufficient, we used *Crotalaria* spp., *Teph-*

* Presented at the annual meeting of the Torrey Botanical Club, Columbia University, New York, January 4, 1944.

TORREYA for April (Vol. 44, 1-16) was issued April 14, 1944.

rosia caudida, Calopogonium and *Centrosema,* not only to hold soil and prevent erosion but we used it as green manure as well. In Java, the practice is to terrace, and every meter or two dig a sump hole on the back end of the terrace about three to four feet long, two feet wide and three feet deep, for aeration and to catch the eroded soil and water, then dig these holes out when filled and pile the soil on the terrace behind. This is good practice where labor is plentiful and cheap.

We then began to check on the alkaloid content of the bark, beginning with two-year old transplants, and set an average content for the area planted, and all plants which by occular survey looked weak or diseased we eliminated, and with this eliminated material the chemists of the Bureau of Science experimented with various methods of extraction. If trees of high alkaloid content were spotted, they were used for bud and seed stock and new areas were planted when seed was produced, and the same procedure of elimination and testing gone through until we had an average alkaloid yield of 9.6% throughout the commercial plantation which today averages better than 10% and some running 14 to 16%.

The trees were pulled as soon as they showed evidence of disease or weakness from two years upward and the average age of final pulling was around six years. Two men could pull a tree by its roots when four to five years old and the bark collected from the roots and stems. Root bark ran higher in content than trunk and stem bark. This method of eliminating by pulling and testing was found the most economical method we could devise. Our goal was the maximum of alkaloid content for the minimum of cost. Some good yielding trees were barked and left growing for bark renewals and seed production, but we found that considerable cross-breeding took place and the seed did not run true to type, so to insure pure type seed we isolated areas with virgin timber as separators.

We noticed that whenever we found early flowering it was an indication that the trees were not growing in their proper environment and that disease, especially cankers, became prevalent. At Impalutao in Bukidnon, at an elevation of 3,800 feet and with a definite dry season, trees flowered at 2½ years, while at Kaatoan, elevation 4,500 feet and no definite dry season, the trees of the same stock flowered at about five years, and disease incidence was greatly reduced and the alkaloid content increased. *Cinchona* flowers about April, May or early June after the dry spells. Flower buds open in 40 to 50 days and mature in 25 to 35 days thereafter. The average height growth per year at Kaatoan was 1.12 meters, the best 1.42 meters.

Our first quantity production of bark took place in about 1927 and some of it sold to European manufacturers. Our analyses in the Bureau of Science at Manila ran between 8.5 and 9.6%, but the Kina Bureau in Holland, which does all the analyses for manufacturers, gave only 7.6%. There was some loss in

shipment and we then began to perfect methods of harvesting and drying, and found that an appreciable saving was made in alkaloid content in quick and proper drying and storage. This is a field where still much can be done. If some method can be worked out for either cheap, quick drying at the point of harvesting, or immediate partial extraction with some portable field grinders and extractors, considerable loss in alkaloid content may be overcome. The average dried bark production at six years of age was .5035 kilos per tree and the harvest was around 3,000 trees per hectare, although 6,000 were planted per hectare.

With the quinine surveys taking place in various regions in Central and South America quite a few new species or varieties will be discovered. The nomenclature today is still nebulous to an average forester, and a good monograph on *Cinchona,* straightening out of the species and varieties, would be most welcome. This monograph should include the alkaloid contents of the bark, because species and varieties vary greatly in their total alkaloid content as well as in the proportion of their main alkaloids—Quinine, Cinchonine, Cinchonidine and Quinidine; and the relation of the individual percentages of these alkaloids is indicative of species and varieties.

A great deal of field work is necessary in the study of the species and hybrids of *Cinchona,* and a detailed study of herbarium material is also essential. Some effort along this line is taking place in the various survey parties spotting *Cinchona* in South America, particularly in Ecuador by Dr. Steyermark.

I have been informed that species have been found at 300 to 400 feet elevation in Colombia and Ecuador, and others as high as 10,500 feet in Ecuador and Bolivia. There is no doubt that some of these species can stand some degrees of frost, drying winds and drought, and grow in a variety of soil conditions. When these factors become known, it will then be quite within the range of possibility to develop by cross-breeding a variety which can grow in acid soils along our Gulf Coast under our own flag, with an alkaloid content of four to five per cent.

Another possibility is to breed for specific alkaloid content. This may develop as a result of research by the medical profession on the use of these specific alkaloids. Today, the Office of Experiment stations, U. S. Department of Agriculture, is carrying on work on cross-breeding in Puerto Rico and Hawaii, and all support possible should be given by the public for this work.

The Division of Plant Introduction and Exploration deserves great credit for the work they have done in handling the Philippine Ledgeriana seed and the hybrids. They have developed techniques completely eliminating damping off, developed controls of light, temperature and moisture, and developed methods of packing and shipping seeds and seedlings. It may also be of interest that the percentage of germination of the Ledgeriana seed I brought from the Philippines was around 96% and after two years of seed storage by the Dutch method

it now runs around 90%. From published reports, Dr. Morrison's office has grown to date 225,000 seedlings which were shipped to the American tropics as follows: Costa Rica 90,000; Peru 50,000; Ecuador 50,000; Mexico 14,000; Brazil 8,500; Salvador 5,000; Puerto Rico 5,000; Nicaragua 2,000; Colombia 1,000.

The results of the development of quinine in the Philippines have led to the development of virgin areas through lumbering, mining and agriculture, by keeping the incidence of malaria down, and have made labor available for jungle work. We were able to produce totaquina at 14 cents per 250-grain treatment, and made a minimum of ten days additional labor per man per year available at an infinitesimal cost in malarial districts. This also led to a greater interest in the development of drug plants as well as useful jungle produce. South and Centra America have hardly been tapped for useful plants for the sinews of our industry.

We have a large field in the development and production of repellents, such as derris and pyrethrum which now appear to be equal in category with quinine in malaria control. The botanist has a wide virgin field in the American tropics in gathering information and knowledge; and the application of this knowledge to the development of plantation crops, to make this hemisphere as self-sufficient as possible, is a challenge which must be met.

Our greatest failing as Americans, as I said at Rutgers University, is "Let George do it." As long as ease of procurement through brokers or import firms has been prevalent our individual manufacturers and industries have not bothered themselves very much with lack of supply, and this is one of the reasons for the rise of syndicates and cartels in primary products. With much waste arid land in the south and west idle, why haven't we developed a tannin and firewood industry with Australian Black Whattle? We are now dependent on foreign sources for our vegetable tannins, our rubbers, guttas, gums, oils, resins, fibres, and medicinal plants, listing just a few of the plants furnishing the sources of many industries. Looking into the future, I predict that a great portion of our edible oils, starches, fibres, tannins and cellulose will be produced in plantation industries in the tropics where a long growing season prevails. Why not prepare for it now?

Another point which deserves consideration is the apparent reluctance of our country to invest government funds in lands or developments in foreign nations. This policy prevents the United States from owning plantations where continued experimentation and research work can be carried on for our own good, as well as for the good of the country where such work is being conducted. Could not some formula be developed whereby non-profit institutions such as universities and foundations could acquire tropical lands either permanently or for extended periods? This proposition might also apply to professional associations, either in combination, or acting as separate entities. This

would encourage a continuity of research, and would permit commercial application of findings under a continuing policy in conjunction with similar institutions in countries best suited for some particular research, study, and development. A reorientation of thinking and of concept is bound to grow out of this war. Agricultural scientists will be called upon to play an all-important role in the future for the joint benefit of our neighbors and ourselves in this Western Hemisphere.

WASHINGTON, D. C.

On the Concept of Type

Alfred Rehder

In a footnote appended to an article on "Polypetalous Forms of *Vaccinium,*" (Torreya **42**: 173. 1942) Camp and Gilly write: "One wonders how the apparent basic, normal material can be considered a variation of an obviously derived and abnormal, vegetatively propagated clone (and therefore, biologically an individual) except where nomenclature is an end in itself rather than a means by which information can be better organized. The writers of this note bow to the accusation that they hold to the principle that nomenclature, as such, should be a tool in the science of systematics, rather than the view that systematics is a mental diversion appended to the science of nomenclature."

Camp and Gilly are certainly right in asserting that nomenclature should be a tool in the science of systematics; that is what nomenclature should be and is. Its aim is to make it possible to designate by certain names certain groups of plants and to assure the greatest possible stability of these names. To attain this aim it is necessary to provide rules to be followed in applying names to groups of plants. As the two basic principles to attain the greatest possible stability, the principle of priority of the names proposed and the type concept have been generally accepted. In regard to the type concept Camp and Gilly seem to be confused in so far as they are apparently not aware that there are two kinds of types in taxonomy, namely the nomenclatural type and the biological or phylogenetic type. The nomenclatural type of a species or subdivision of a species is the plant or specimen (or in some cases a description or figure) upon which the name is based, therefore the term "typicus" used as a name for a subdivision of a species refers to the nomenclatural and not to the biological type. The type of a genus is the species, and the type of a family is the genus, upon which the name is based. If a name is based on several species or on several genera simultaneously without the author indicating a certain group as type, the group which best represents the concept of the author is to be selected as lectotype.

In most cases the nomenclatural type and the biological type are identical, but there are cases when the nomenclatural type is clearly a derivative of the group representing the biological type, as in *Rhododendron linearifolium* of which Camp and Gilly say: "One wonders how the apparently basic normal material can be considered a variation of an obviously derived vegetatively propagated clone . . ." but the fact is that no one considers *R. macrosepalum* Maxim. a variation or derivative of *R. linearifolium,* and even Makino who proposed in 1908 the combination *R. macrosepalum* var. *linearifolium* changed it in 1913 to *R. linearifolium* α. *linearifolium* and called the biological type *R. linearifolium* β. *macrosepalum,* because *R. linearifolium* Sieb. & Zucc. of

1846 has priority over *R. macrosepalum* Maxim. of 1870 and represents the nomenclatural type of the group including *R. macrosepalum*. There are many cases, particularly in double-flowered forms, as *Spiraea prunifolia* Sieb. & Zucc., *Rosa Roxburghii* Tratt., *R. xanthina* Lindl. and some other species of *Rosa*, in which the double-flowered form is the nomenclatural type, while the biological type was described later and, if distinguished by a name, must be treated as a variety or form. In such cases, it is clear which form represents the nomenclatural and which the biological type, but in species with geographical or ecological variations opinions may differ as to which is to be considered the phylogenetic type, and if each author were allowed to express his opinion by proposing changes in nomenclature, confusion and instability of names would follow. An author is always free to express his opinion but has no right to change names or combinations of names which are in accordance with the rules of nomenclature.

Arnold Arboretum, Harvard University
Jamaica Plain, Massachusetts

Improved Rooting of Cryptostegia Cuttings Callused on the Plant

H. F. Loomis[1] and J. H. Heuer[2]

Vegetative propagation of plants of the first generation hybrid between *Cryptostegia grandiflora* and *C. madagascariensis,* having superior rubber content of leaves or high latex yield, is essential for increasing stocks of selected plants. Standard types of stem cuttings collected in various ways, subjected to different treatments, including the use of many growth promoting substances of various strengths, have been tried. The results indicate that with almost any type of material or treatment rooting takes place more rapidly and extensively where bottom heat can be applied in the propagating box and maintained at temperatures of 85° to 90° F., with the tops of the cuttings exposed to materially lower temperatures. During the summer such conditions cannot be maintained and rooting results generally have been much less satisfactory. Under the best conditions root production has been slow and, only in cuttings treated with Rootone or talc dust containing 1000 p.p.m. of naphthalene acetic acid or naphthyl acetamide, has the percentage with strong roots and satisfactory leaf development been fairly high.

Air-layering or marcottage of branches directly on the plants has been found a fairly satisfactory means of propagation. A relatively high proportion of the treated branches take root and the roots are stronger and more vigorous than are developed by most types of cuttings under the best treatments. Chief objection to the marcottage method is its cost in labor, material, and time.

In marcottage of Cryptostegia stems, the first step is the removal of a complete ring of bark one to two centimeters in length at the base of the portion to be rooted, being sure that no cambial tissue remains to bridge the girdled area. Such girdling does not kill the stem above it and several weeks after the marcotte box is applied a callus forms and roots may be expected to appear somewhat later. The success of this girdling method with marcottes suggested that girdling of stems from one to ten days before making cuttings might cause better and more prompt formation of roots on the cuttings, but extensive trials showed no advantage of such treatment over cuttings not previously girdled.

In harvesting these girdled stems for cuttings, or in the girdling of stems for marcotting, some were overlooked and remained on the plants without further attention. Several months later it was observed that these girdled stems were still alive and that a large callus had formed on each at the upper edge of the girdled area at what would have been the bottom of the cutting. Five

[1] Senior agronomist, Division of Plant Exploration and Introduction.

[2] Principal scientific aid, Rubber Plant Investigations, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration.

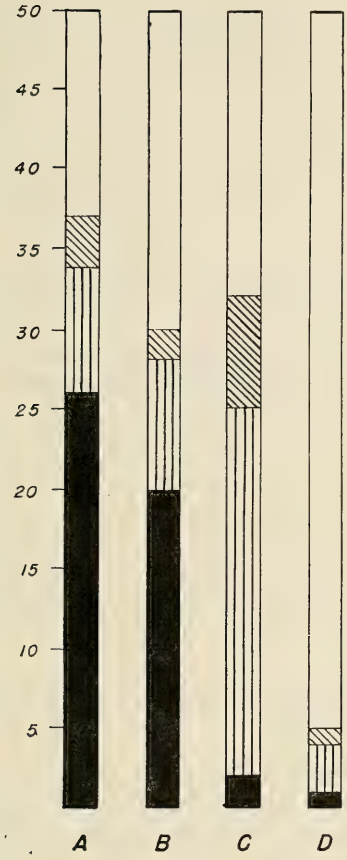

DIAGRAM 1

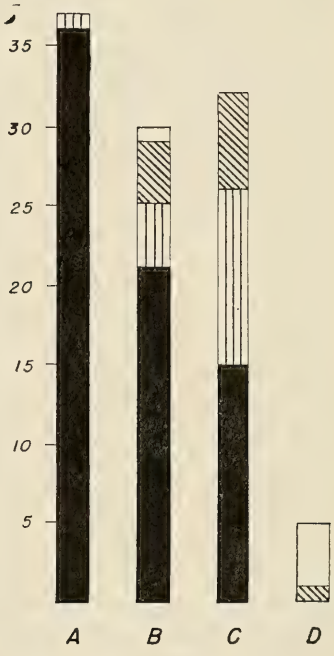

DIAGRAM 2

DIAGRAM 1. Total number of cuttings that rooted and time required for the roots to develop in 100 "old girdled" cuttings and 100 ungirdled cuttings, half of each lot being treated with Rootone and half left untreated. Columns A and B are "old girdled" cuttings; C and D are ungirdled cuttings. Cuttings in columns A and C treated with Rootone. Solid black portion of columns represents the cuttings that rooted in 10 days; vertically-hatched portion, the additional cuttings that rooted in 17 days; obliquely-hatched portion, the additional cuttings that rooted in 22 days; blank portion, the cuttings that failed to root in 22 days.

DIAGRAM 2. Character of roots produced by the cuttings shown as rooted in diagram 1, with arrangement of columns and treatment of cuttings in them the same. Black portion of columns represents cuttings that produced strong roots; vertically-hatched portion, cuttings with good roots; obliquely-hatched portion, cuttings with fair roots; blank portion, cuttings that developed only poor roots.

months after the girdling of these stems 84 were found to be heavily callused and cuttings were made of them, half having the callus dusted over with talc containing 4000 p.p.m. of indolebutyric acid and the other half left untreated. The cuttings were placed in the usual coarse sand medium in the propagating box with bottom heat. In seven days roots had begun to form and in twenty days 38 of the treated cuttings had rooted whereas only 23 of the untreated cuttings had roots. This rooting had taken place more quickly than with either marcottes or other cuttings previously tried and the roots were exceedingly sturdy, in most cases the equal of roots produced by marcotted stems.

These results led to a more extensive test of rooting what are referred to hereafter as "old girdled" cuttings. In the middle of December 1942, sufficient stems were girdled and left on the plants to provide 100 cuttings. These cuttings were harvested on July 13, 1943, having developed typical large calluses at the base. Fifty of these cuttings were placed in the propagating box without treatment and 50 were treated with Rootone dust over the callus. At the same time 100 cuttings of the same size were cut from the plant without previous girdling, half being treated with Rootone dust, the remainder being left untreated, and all placed in the propagating box with the "old girdled" cuttings. Inasmuch as this test was conducted in the summer, use of bottom heat to maintain a higher temperature differential at the base of the cuttings than at their top was impracticable.

All cuttings were examined for roots in ten days, on July 23, and again seven days later on July 30, with the final inspection five days later on August 4, when the experiment was discontinued.

The results of these experiments are presented in the two accompanying diagrams, the first of which shows the number of cuttings that rooted in each treatment and the rapidity with which they rooted. Not only did untreated "old girdled" cuttings root in greater abundance than did untreated check cuttings but their speed of rooting was even more rapid than with check cuttings treated with Rootone. Total rooting of untreated "old girdled" cuttings was essentially the same as with Rootone treated check cuttings. The most striking effect from the use of Rootone was to increase greatly the rooting of the ungirdled check cuttings. It also increased somewhat the rooting of "old girdled" cuttings. The relative speed of rooting in any of the cuttings appears not to have been materially affected by Rootone treatment.

Diagram 2 shows the effects of the different treatments upon the type of roots produced by the cuttings in diagram 1. It will be seen that only poor to fair roots were produced by untreated, ungirdled cuttings whereas the use of Rootone on ungirdled cuttings caused more than a third of them to produce strong roots and a similar number to produce good ones. A much higher proportion of untreated "old girdled" cuttings produced strong roots than where Rootone was used on ungirdled cuttings but the use of this substance on "old

girdled" cuttings strikingly increased the number with strong roots as all but one of the 37 cuttings produced roots in this category.

Thus it appears that girdling to cause formation of large calluses, with great food storage capacity, not only increases the rooting expectancy of cuttings but their speed of rooting and size of roots as well. These conditions also may be improved still further by use of Rootone on the callus at the time the cutting is made.

Another conclusion that may be drawn from these tests is that summer rooting of "old girdled" cuttings may be as good, if not better, than rooting in cooler weather when a temperature differential may be maintained with bottom heat.

U. S. Plant Introduction Garden
Coconut Grove, Florida

PROCEEDINGS OF THE CLUB

Minutes of the Meeting of December 7, 1943

The meeting was called to order at 8:15 p.m. by the President, Dr. William J. Robbins, in Room 601 Schermerhorn Hall, Columbia University. There were 150 members and friends present.

The minutes of the preceding meeting were accepted as read.

The budget for the year 1944 was presented by Dr. Levine, and a motion for its acceptance was passed by the Club.

Dr. Robbins announced the Annual Meeting and Dinner to be held at the Men's Faculty Club, Columbia University, on January 4, 1944.

The scientific program consisted of a lecture by Dr. Charles Thom entitled "A Mycologist Looks at Antibiotics, Especially Penicillin." The speaker's abstract follows:

To a group of botanists, the current literature of antibiotic substances presents a concept not new but expressed in quite different terms from those familiar. It has long been known that a walnut tree discourages some other plants from living near by. Windling first regarded the attack of *Trichoderma* upon other molds as parasitism. I reported *Penicillium rugulosum* as attacking and destroying *Aspergillus niger*. Others discussed the "staling effect" which kept two molds grown in the same Petri dish from overrunning each other. Miss Morrow found a whole series of molds and bacteria in Texas soil which would inhibit *Phymatotrichum*, the root rot organism of cotton, in Petri dish cultures. The change of interpretation came when Fleming showed that his strain of *Penicillium notatum* produces a substance which can be isolated and used to stop the growth of bacteria. Florey and his colleagues followed Fleming and laid a foundation for producing penicillin as a therapeutic agent.

Today we have a large number of laboratories and manufacturing plants putting all their energy into the adjustment of laboratory and industrial procedures to the demands of *P. notatum* in producing penicillin. Certain features of this fermentation must be discussed. (1) The mold being aerobic can be grown in "still" culture, i.e. on the surface of liquid and solid media without agitation, or in submerged culture in liquids that are thoroughly aerated by some shaking apparatus, by stirring or by blowing air through the mass. Under these conditions the mold grows as pellets of hyphae; short, coarse cells radiating from growth centers to form masses up to 2 mm. in diameter without producing conidia. (2) To produce a satisfactory yield, however, the mycelial mass must all reach the physiologically mature or spore producing stage at one time. Penicillin is produced at this stage whether spores actually appear or not. (3) *P. notatum* is unstable under continuous culture. Unless handled carefully a strain breaks down into several, differing in appearance, amount of spore production, and often producing very little penicillin. (4) New strains have been collected from widely different lands. These vary from producing very little penicillin to strains approximating the best we have. (5) Manufacture procedures proposed vary from 1,000 gallon vats to large flasks on the shaking machine, or in still culture to many types of bottles, flasks, test tubes, or gauze. It is hoped that the needs will be met by a combination of these proposals.

After animated discussion and inspection of the samples and literature which Dr. Thom provided, the meeting adjourned at 9:40 p.m.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of December 15, 1943

The meeting was called to order at 3:30 p.m. by the President, Dr. William J. Robbins, in the Members Room at The New York Botanical Garden. Thirty members and friends were present.

The minutes of the preceding meeting were accepted as read.

The scientific program of the afternoon was presented by Dr. Harold W. Rickett of The New York Botanical Garden. Dr. Rickett talked about his experiences on his recent trip to Mexico. He told of his visits with some of the botanists associated with the educational institutions of Mexico. He had on display some very interesting photographs and drawings made during his trip.

The meeting adjourned at 4:30 p.m. Tea was served by members at the Garden.

Respectfully submitted,

Honor H. Hollinghurst
Recording Secretary

Minutes of the Annual Meeting, January 4, 1944

The annual dinner meeting was held on the evening of January 4, 1944 at the Men's Faculty Club of Columbia University. Seventy-eight members and friends were present.

The meeting was called to order by the retiring President, Dr. William J. Robbins. The minutes of the preceding meeting were accepted as read.

Dr. Robbins announced that the presentation of the annual reports by the officers of the Club would be deferred until the next meeting.

Dr. Matzke, Chairman of the Ballot Committee, reported that the following people had been elected to office for the year 1944:

President: Michael Levine
1st Vice-President: Fred J. Seaver
2nd Vice-President: H. K. Svenson
Corresponding Secretary: Edwin B. Matzke
Recording Secretary: Honor M. Hollinghurst
Treasurer: Page J. Karling
Editor: Harold W. Rickett
Bibliographer: Lazella Schwarten
Business Manager: Harold H. Clum

Members of the Council: J. S. Karling, E. H. Fulling, Rutherford Platt, Lela V. Barton

Delegate to the Council of the New York Academy of Sciences: Bernard O. Dodge

Representative on the Board of Managers of The New York Botanical Garden: Henry A. Gleason

Representatives on the Council of the American Association for the Advancement of Science: John H. Barnhart, Albert F. Blakeslee

Dr. Robbins then introduced the newly elected President, Dr. Levine, who spoke a few words of greeting to the Club.

The guest speaker of the evening, Colonel Arthur F. Fischer, G.S.C., was introduced by Dr. Robbins. Colonel Fischer discussed the problem of quinine and its production. His speech, in its entirety, is published in this number of TORREYA, pp. 1-5.

The meeting was adjourned at 8:30 p.m. to permit informal discussion and meeting with friends.

Respectfully submitted,

HONOR H. HOLLINGHURST
RECORDING SECRETARY

MINUTES OF THE MEETING OF JANUARY 19, 1944

The meeting was called to order at The New York Botanical Garden by the President, Dr. Levine. There were 22 members and guests present. The minutes of the annual meeting of January 4, 1944, were accepted as read. Dr. Levine appointed an auditing committee consisting of Dr. Dodge, Chairman, Dr. Seaver, and Mr. Montagne. Mrs. Karling, the new Treasurer, was invited to attend the meetings of the committee. It was moved by Dr. Robbins and voted by the Club that the following communication sent by Dr. Graves concerning Dr. Herbert M. Denslow be spread upon the minutes:

Dr. Herbert M. Denslow, the oldest living member of the Club, who will be 92 years old this coming August, a former President of the Club and Editor of the BULLETIN, sends his greetings to the Club and regrets that he cannot be present at the Annual Dinner. He wishes the Club members a Happy New Year and assures them that he is comfortable and being well cared for.

The scientific program consisted of an illustrated lecture by Dr. Robert Bloch of Yale University on "New Experiments on Cellular Differentiation and Histological Pattern." The speaker's abstract follows:

Various types of regeneration of histological pattern were studied in *Monstera deliciosa, Coleus hybridus,* and *Taraxacum kok-saghyz.* The study of cellular differentiation and histological pattern in plants by means of regeneration experiments in more or less mature, differentiated zones has various advantages. Compared with the fully embryonic apical growing points, cells are here large, vacuolate and more thick-walled, and thus the changes both in cytoplasm and membranes can be much better observed.

One frequent pattern in plants, which forms a common feature of generally more complex tissue patterns, is formed by successive layers of suberized cells, lignified, sclerotic elements and parenchymatous cells, arranged in concentric fashion. This pattern is often developed as a dermal pattern, adjacent to a great variety of external and internal, normal and pathological surfaces, cellular centers, and lacunae (e.g., hypodermis, exodermis, secretory ducts, necrotic centers). In *Monstera deliciosa,* this pattern could be induced or regenerated in various positions, but always in conjunction with an outer or inner surface. The developmental potency of forming this pattern is not reached before the cells and tissues have attained a certain age, but is still present in comparatively old, differentiated parenchyma and collenchyma cells. External conditions, such as oxygen supply and humidity, influence the character of the pattern; and intracellular changes also suggest that metabolic processes, at or near surfaces, are instrumental in the induction of this pattern.

Another example of regeneration of histological pattern is the differentiation of xylem strands in vacuolate parenchyma cells in the wounded internode of *Coleus.* The plane of cell division and wall differentiation do not show here as immediate a relation to the wound surface as in *Monstera.* However, the bands of lignified thickening in successive groups of differentiating xylem cells show an orderly arrangement, both in relation to each other and to a visible configuration in the cytoplasm (granules and streaming) which precedes them. This suggests the presence of a cytoplasmic pattern which, corresponding to the phragmosome in cell division, is here the basis of differentiation in the cell wall.

In both *Coleus* and *Taraxacum* older xylem elements are gradually dissolved in the wound tissue; this process is initiated by the formation of tyloses in the vessels.

The formal meeting adjourned at 4:40 p.m., but an informal discussion of Dr. Bloch's paper continued over the refreshments generously provided by the ladies of The New York Botanical Garden.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of February 1, 1944

The meeting was called to order at 8:20 p.m. by President Levine in Schermerhorn Hall, Columbia University. Forty-four members and friends were present.

The minutes of the preceding meeting were approved as read.

Twelve persons were unanimously elected to annual membership, and two to associate membership. One transfer from associate to annual membership was approved. Dr. Roland Harper was unanimously elected to honorary life membership. The resignations of 25 annual members and of 31 associate members were accepted with regret.

The Treasurer's Annual Report for 1943 was read by Dr. Whaley, as follows:

Balance as of January 1, 1943		$ 2,301.12
Cash received, January 1-December 31, 1943 (Transactions include internal items of $20,000)	$ 25,911.62	
Total		$ 28,212.74
Cash disbursed, January 1-December 31, 1943	$ 27,224.04	
Balance		$ 988.70
Less endowment monies in cash account	$ 43.57	
Actual cash in checking account	$ 945.13	
Cash in current expense account	$ 1,033.32	
Cash on hand, January 1, 1944		$ 1,978.45

The smaller balance at the end of 1943 than at the end of 1942 is largely the result of late mailing of dues bills bringing most of the payments after the end of the year, and expenditure of $1,000.00 during 1943 for a MEMOIR actually published in 1942. The balance reported at the end of 1942 did not include money set aside in a cash reserve fund. The net balance at the end of 1943 is approximately the same as the actual unobligated balance at the end of the previous year. The Club lived within its income during 1943, something which had not been done in the several preceding years. In general the financial status of the Club at the present time is excellent despite many factors imposed by war conditions.

It was moved by Dr. Small that the Club accept the report of Dr. Whaley with an expression of thanks for his services as Treasurer. The motion was seconded and passed.

The scientific program for the evening was presented by Dr. W. Gordon Whaley who discussed "Rubber Bearing Plants in the Present Emergency." His talk was well illustrated with Kodachrome slides. Dr. Whaley's paper will be published in TORREYA in the near future.

Following discussion of the subject, the meeting was adjourned at 9:55 p.m.

Respectfully submitted,

HONOR M. HOLLINGHURST
RECORDING SECRETARY

THE TORREY BOTANICAL CLUB

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William J. Robbins
Fred J. Seaver
Henry K. Svenson
Edwin B. Matzke
Honor M. Hollinghurst
Page J. Karling
Harold W. Rickett
Harold H. Clum
John A. Small
Bernard O. Dodge

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1942-1944	1943-1945	1944-1946
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W. J. Bonisteel	Clyde Chandler	E. H. Fulling
Arthur H. Graves	Albert E. Hitchcock	J. S. Karling
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George H. Shull
A. B. Stout
P. W. Zimmerman

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John A. Small, *Chairman*

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Vernon L. Frazee
Eleanor Friend
Alfred Gundersen
Robert Hagelstein
Louis E. Hand
Fred R. Lewis
James Murphy
G. G. Nearing
Rutherford Platt
Daniel Smiley, Jr.
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William J. Robbins
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Cryptogams

Ferns and Fern Allies: R. C. Benedict, W. Herbert Dole, N. E. Pfeiffer
Mosses: E. B. Bartram
Liverworts: A. W. Evans, E. M. Matzke
Freshwater Algae: H. C. Bold, J. J. Metzner
Fungi: A. H. Graves, J. S. Karling, Fred R. Lewis
Lichens: J. W. Thomas, Jr.
Myxomycetes: R. Hagelstein

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OTHER PUBLICATIONS

OF THE

TORREY BOTANICAL CLUB

(1) BULLETIN

A journal devoted to general botany, established in 1870 and published bi-monthly at present. Vol. 70, published in 1943, contained 676 pages and 5 plates. Price $6.00 per annum. For Europe, $6.25.

In addition to papers giving the results of research, each issue contains the INDEX TO AMERICAN BOTANICAL LITERATURE—a very comprehensive bibliography of current publications in American botany. Many workers find this an extremely valuable feature of the BULLETIN.

Of former volumes, 24-70 can be supplied separately at $6.00 each; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Single copies ($1.00) will be furnished only when not breaking complete volumes.

(2) MEMOIRS

THE MEMOIRS, established 1889, are published at irregular intervals. Volumes 1-19 are now completed. Volume 17, containing Proceedings of the Semi-Centennial Anniversary of the Club, 490 pages, was issued in 1918, price $5.00.

Volume 19, no. 1, 92 pages, 1937, price $1.50. Volume 19, no. 2, 178 pages, 1938, price $2.00. Volume 19, no. 3, 76 pages, 1940, price $1.25. Volume 19, no. 4, 58 pages, 1941. Volume 19 complete, price $5.00.

Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

Reprinted monthly on cards, and furnished to subscribers at three cents a card.

Correspondence relating to the above publications should be addressed to

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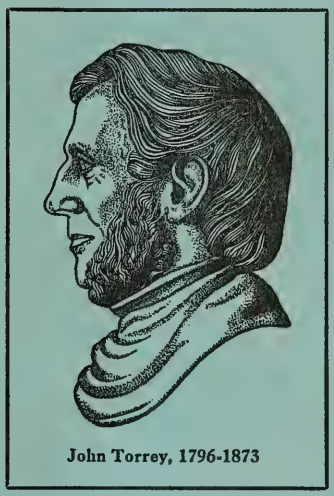
New York 27, N. Y.

Volume 44 July 1944 Number 2

TORREYA

EDITED FOR
THE TORREY BOTANICAL CLUB
BY
HAROLD H. CLUM



John Torrey, 1796-1873

CONTENTS

Western Hemisphere Natural Rubber.....W. Gordon Whaley 17

Three New Saprophytic Chytrids.....Anne M. Hanson 30

Cuscuta japonica Choisy, an Asiatic Species New to America.....T. G. Yuncker 34

Reviews

The Vegetation and Floristics of Bull Run Mountain, Virginia.....S. F. Blake 36

Field Trips of the Club..... 37

Proceedings of the Club..... 39

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MEMBERSHIP IN THE TORREY BOTANICAL CLUB

All persons interested in botany are invited to join the Club. There are four classes of membership: *Annual,* at $5.00 a year; *Associate,* at $2.00 a year; *Sustaining,* at $15.00 a year; and *Life,* at $100.00. The privileges of all except *Associate* members are to attend all meetings of the Club, to take part in its business, and to receive all current publications, except the *Memoirs* which are sold to members at cost. *Associate* members have the privilege of attending all meetings and field trips. They also receive the *Schedule of Field Trips* and the *Bulletin* of the New York Academy of Sciences. Applications for membership should be addressed to the Treasurer.

TORREYA

TORREYA was established in 1901 as a monthly publication of the **Torrey Botanical Club** for shorter papers and interesting notes on the local flora range of the Club. It also contains the proceedings of the Club, reports of field trips, and some book reviews and news notes. Volume 43, published last year in two numbers, contained the papers presented at the 75th Anniversary Celebration of the Club in June 1942, and an account of the Activities of the Club during 1943. For the year 1944 TORREYA will resume its former function, but will be published in only four numbers.

The editor invites contributions for future numbers of TORREYA. These should be typed with double spacing on one side of standard paper. Illustrations should be mounted on stiff cardboard, with the desired reductions plainly indicated, and so designed as to fill the full width of the page (4⅝ inches) and any portion of the height (7⅛ inches). Legends for illustrations should be typed and included with the manuscript (*not* affixed to the figures).

The subscription price of TORREYA in the United States and Canada is $1.00 a year, for subscribers elsewhere, 25c extra; single copies, 40c. Of the annual membership dues of the **Torrey Botanical Club**, $0.50 is for a year's subscription to TORREYA.

Claims for missing numbers should be made within sixty days from the date of mailing.

Subscriptions and requests for back numbers should be addressed to the Treasurer, Page J. Karling, Department of Botany, Columbia University, New York 27, N. Y.

Manuscripts for publication, books for review, reports of field trips, and news items should be addressed to:

HAROLD H. CLUM
HUNTER COLLEGE, 695 PARK AVENUE
NEW YORK 21, N. Y.

TORREYA

VOL. 44 JULY 1944 NO. 2

Western Hemisphere Natural Rubber*

W. GORDON WHALEY

In 1940 the United States imported some 818,000 long tons of rubber, valued at $318,000,000. Of this amount 650,000 long tons were used within the country. Ninety-seven percent of this rubber came from the Far East. The outbreak of war in the Pacific and the subsequent loss by the Allied Nations of Malaya and the East Indies thus deprived us of the main source of a strategic material, the indispensability of which, already familiar, has loomed larger with each day of war. By the time war came the seriousness of the rubber situation had begun to be realized and certain steps were taken to meet the crisis. These steps were along two different approaches—the building of a synthetic rubber industry, and the development and exploitation of sources of natural rubber within the Western Hemisphere.

The construction of four 2500-ton capacity, government-owned synthetic rubber plants was authorized in 1941. Around this nucleus has been built the industry which it is estimated will produce some 800,000 tons of synthetic rubber in 1944.

The history of the development of synthetic rubber is almost as long as the period of commercial utilization of rubber. An outline of the early steps is given by H. & R. Wolf (1936). There had been several attempts to analyze rubber in the early 19th century, none of them very revealing. Then in 1860 Greville Williams isolated a low-boiling point fraction which he named *isoprene*. From this isoprene Williams was able to build up, by polymerization, a substance having some of the properties of rubber. Several other investigators subsequently pointed out the apparent relation between isoprene and rubber and by 1880 the production of isoprene from simple materials was thought to be the only step necessary to make the production of synthetic rubbers practical. Between 1882 and 1884 a process for the manufacture of isoprene from turpentine was perfected. The step from isoprene to a rubber-like compound proved too time-consuming, however, until in 1910 it was found that sodium metal would bring about polymerization. In that year the manufacture of isoprene rubber from methyl isoprene produced from acetone with the aid of sodium was begun in Germany.

* Presented at the meeting of the Torrey Botanical Club on February 1, 1944 at Columbia University, New York, N. Y.

TORREYA for July (Vol. 44, 17-44) was issued July 21, 1944.

Between 1910 and 1941 much progress was made on the problems of producing synthetic rubbers. Various sources of isoprene were investigated and chloroprene, butadiene, and other compounds for use instead of isoprene were developed. Facts were learned about the polymerization of these materials and co-polymerization with other hydrocarbons.

The point to be understood is that synthetic rubber is no eleventh hour miracle developed in response to the war emergency. The conditions imposed by war have accelerated certain phases of synthetic rubber development, but the underlying facts have been accumulated over a long period of time. Knowing this, one is more inclined to appreciate the many difficulties that have been involved in the manufacture of satisfactory synthetic rubber. Monumental progress has been made toward overcoming these difficulties, and in constructing and putting into operation plants for the production of synthetic rubbers. The final answer has not yet been obtained. Hundreds of chemists are working on the problems and continued improvement in quality and usefulness may be expected. Up to the present, however, the production of synthetic rubber has not alleviated the critical need for natural rubber.

It is perhaps worth mentioning here that actually there is no such thing as synthetic rubber. If there were there would probably be no need for natural rubber. So-called synthetic rubbers are substances having some of the essential physical properties of rubber, but none of the synthetics has the chemical structure of rubber and none has all of its physical properties. There are many types of synthetic *elastomers* or *plastomers*. A synthetic elastomer, to be designated as synthetic rubber, must be a substance capable of vulcanization and after vulcanization must stretch to at least four times its normal length and then resume its original length forcibly and rapidly when the pressure is released. GR-S, or the Buna type, synthetic has this property, but in going through the procedure generates vastly more heat than natural rubber. It is this factor which limits its use in tires where there is rapid flexing.

Large amounts of natural rubber are needed for combining with the synthetics in the manufacture of larger size truck and bus tires. Many uses still demand pure natural rubber. When these facts are considered in the light of the daily growing demands for both military and civilian products made of rubber, the necessity of increasing our supplies of natural rubber is highlighted.

Attempts to increase and assure our supply of natural rubber have been three-fold and all were initiated in 1940. Agreements were made with several of the Tropical American countries whereby the United States government undertook, through an official agency, to guarantee the price of crude rubber over a fairly long period—in most cases extending to 1946. This move was aimed at stimulating the collection of rubber from *wild* trees in Central and

South America. A correct estimate of the number of such trees and the amount of rubber that could be obtained from them would be very difficult to make. Published guesses have indicated as many as 300,000,000 trees, a probably fantastic figure, with an attainable yield of 50,000 tons of rubber annually, but there are many serious complications involved in the collection of this wild rubber in large quantities.

Cooperative arrangements have been made with 14 of the Latin American countries for the development of rubber plantations. These plantations have the double aim of increasing the available supply of rubber during the present emergency if it is prolonged and assuring a dependable Western Hemisphere supply of rubber in the future. A summary of the plan for establishing a self-sustaining rubber-growing industry has been published by Brandes (1941).

In addition all plants holding any promise of being useful in providing a domestic source of rubber are being thoroughly investigated.

Hevea brasiliensis. The most important source of rubber is *Hevea brasiliensis,* the Para rubber tree. This tree, apparently long known to the South and Central American Indians, made its first appearance in white man's records in the early 18th century.

In 1770 Priestley discovered that rubber, in this case from India, would erase pencil marks, hence the name *rubber* and the persistence of the term *India rubber* even after the majority of our rubber came from a South American tree. In 1823 Charles McIntosh found that rubber is soluble in benzene. This discovery broadened the uses for waterproofing as previously only freshly collected latex could be used for coating cloth.

In 1839 Goodyear came accidentally upon the knowledge that rubber could be vulcanized by mixing with sulphur and heating. This resulted in an elastic material which did not become sticky in hot weather and could stand much lower temperatures than crude rubber without becoming brittle. An amazing number of uses were immediately found for the vulcanized product. The demand rose so rapidly that whereas in 1849 rubber was collected from *Hevea brasiliensis* only in the vicinity of the city of Para, in 1850 some 25,000 people were concerned in its collection in the State of Para alone, and collectors had ascended far up the tributaries of the Amazon. As the uses of rubber increased it was collected in varying amounts from many different plants but the Para rubber tree remained the most important, except perhaps for a brief period just after the turn of the century when guayule became a very large producer.

In 1876 Henry Wickham, later knighted in consideration of his contributions to the British Colonial interests, took seeds of *Hevea brasiliensis* from the Amazon region to Kew. He then introduced the tree, using Kew-grown material, into India, Ceylon, the Straits Settlements, and the Dutch East

Indies. There followed an amazing development of the rubber plantations in the East, paralleled by the nearly complete abandonment of the rubber production industry in the Western Hemisphere.

The latent danger in the complete dependence of the United States on eastern rubber supplies gave rise to governmental action in 1940 when a bill was passed by Congress authorizing expenditure of a half million dollars for investigations directed toward the development of rubber production in the Western Hemisphere. The Bureau of Plant Industry was charged with the conduct, in cooperation with other agencies, of these investigations.

The first step was a survey of the Western Hemisphere areas falling within the range to which *Hevea* is adapted, or in other words between the equator and about 20° of latitude. Simultaneously plans were laid for the development of rubber plantings within suitable areas. The general plan is for the development of small one-man or one-family plantations in regions having the proper soil and being otherwise climatically and economically adapted. It is thought that small-farm rubber cultivation has a far greater chance of success in the Western Hemisphere than would large plantation enterprises, although an interspersion of large and small units is probably most desirable.

The most serious problem relating to the cultivation of *Hevea* in Latin America is the widespread presence of the South American leaf blight, caused by *Dothidella ulei*. This disease is spread through the whole native range of *Hevea* in the Amazon Valley and its further spread to other Latin American areas where *Hevea* can be grown successfully is quite likely. It has been the cause of the abandonment of numerous former attempts to establish rubber plantations in the west. However, in the last ten years or so several disease resistant clones have been developed, mostly in the plantings of the Ford Motor Company begun in 1927 in Brazil, and in those of the Goodyear Tire and Rubber Company begun in 1935 in Panama, and in 1936 in Costa Rica. Further selection of resistant strains for building of clones is one of the goals of the present cooperative program. A discussion of the disease problems and the methods used for overcoming them is given by Rands (1942) in an article regarding the various aspects of Hevea culture in Latin America.

The other aim of the selection and breeding work under way is the development of high-yielding strains. Many of the eastern clones of *Hevea* selected and bred during the last few years have exceedingly high rubber yields. The combination of these high rubber yields with high leaf blight resistance is counted upon to provide superior strains for the new western plantings.

Castilla elastica deserves mention in any roster of the rubber bearing plants, not because it plays any appreciable part at present in the cultivation

of rubber but because of the part which it plays as a wild rubber source. It was at one time as important as *Hevea* in the production of natural rubber, and in the late nineteenth century and early twentieth century large numbers of Castilla trees were planted in Latin America.

Castilla, also called, though erroneously, *Castilloa,* is a member of the mulberry family and extends from Mexico southward into Bolivia, Brazil and Peru (Loomis 1942). Rubber is gathered from *Castilla* by tapping, but it differs from *Hevea* by giving a relatively large amount of latex at each tapping, but can be tapped only a few times a year without serious injury. It has been a common procedure to cut large Castilla trees for their rubber yield which may be as much as 50 pounds from one felled tree. *Castilla* has played a large part in the supplying of so-called "wild" rubber during the present emergency.

Guayule, *Parthenium argentatum,* was "discovered" by Dr. J. W. Bigelow of the Mexican Boundary Survey in 1852 "near Escondido Creek, Texas." It was described and named by Asa Gray in 1859. Guayule is native to the North Central plateau region of Mexico extending into the Big Bend region of Texas. Within the area it is confined rather strictly to limestone soils and is generally restricted to altitudes between 3000 and 7000 feet, where rainfall averages from 10-15 inches a year.

A detailed description of Guayule and its characteristics has been published by Lloyd (1911, 1932). Guayule is a member of the Compositae, a low-growing, much branched, woody shrub with small silver-gray leaves. Wild plants are generally about two feet in height, and have a dry weight of one or two pounds after several years growth. Hardy perennials in habit, undisturbed plants probably live some 30 to 40 years. There is occasionally some vegetative reproduction but most of the reproduction is by seed. Under favorable conditions large numbers of seeds are produced, but in very dry periods particularly, seed production is limited. In semi-arid regions to which the plant is native it has great capacity to withstand long continued droughts. However, under drought conditions very little growth takes place.

The rubber in guayule occurs in latex, but in contrast to the situation in *Hevea* and the other so-called latex-bearing plants the latex is not found in vessels or tubes but is a component of the individual parenchymatous cells. Rubber is stored in all parts of the plant except perhaps the leaves. In wild plants the rubber content usually averages around 7% of dry weight for mature plants. Cultivated selected strains run as high as 22% rubber at maturity.

The Germans began experimenting with the extraction of guayule rubber before 1900 but the product remained unimportant until in 1904, a factory, using a pebble-mill extraction process, was set up in Torreon, Mexico. Other factories followed and small-scale production of rubber from guayule has been almost continuous since, except during one period of very low rubber prices.

The supply of wild guayule is strictly limited, however, and, except for the imposition of conservation measures, would have been exhausted some time ago. It is estimated that a constant production rate of 7,000 to 10,000 tons a year would be possible in Mexico without depleting the natural supply.

Any increase in the production of guayule depends upon cultivation of the shrub. Two projects for the furtherance of guayule cultivation were begun in the early days of the war. One of these has been directed toward intensive cultivation of the plant in the United States, largely in California, the other toward a considerably less intensive cultivation in areas of Mexico presenting adapted lands but a vastly different economic picture (Brandes 1942a). The procedures of maintenance, and to some extent those of planting and harvesting, are unlike in the two areas, but fundamentally the problems of domestication are the same.

To begin with germination of guayule seed when and where desired is a difficult accomplishment. In the wild, germination hinges on the presence of large amounts of moisture for the elimination of the inhibitors. Nursery practice consists of chemical treatment of the seed followed by preplanting germination in chambers. The seeds are then mixed with sawdust or sand, and kept very moist until the seedlings are established. Naturally this procedure presents serious problems in disease control. The use of rigid sanitary measures, strict water regulations, and use of resistant strains is dictated. Seedlings are grown in nursery beds usually from March or April until January of the following year. The length of time allowed between transplanting and harvesting depends a great deal upon conditions. At least two years' growth is necessary and maximum rubber content is not reached for many years. The plan for cultivation in California originally called for harvesting the major portion of the plants in the fourth year. Because of the urgency for early production it is planned to harvest much of the area after only two years.

Most interesting of the problems connected with the growth of guayule in the field are those arising from the relation of growth to rubber formation. It was early observed that if conditions for growth are very favorable plants of guayule would grow to a very large size but would contain practically no rubber. On the other hand small, but mature plants often contained large percentages of rubber. Study has revealed that little rubber is formed during periods of active growth, and that if growth has been very good little rubber is formed in a subsequent less active growth period. In guayule the cortical tissue is the main rubber-bearing region. This tissue is laid down, or at least differentiated mostly during periods of slow growth, and only following a general growth phase. A seasonal rhythm of growth and rubber formation has been found and cultivation practices are now directed toward following this rhythm. Attempts are made to produce fairly vigorous growth early in the season and then permit a gradual drying to limit growth by mid-summer.

Rubber is then produced freely during the late part of the season. The procedure calls either for some irrigation during the early part of the season in semi-arid regions, or in California by fitting the time of planting to utilization of winter rains to the greatest advantage.

In the California plantings the small first-year plants grow fairly vigorously all summer by drawing on the winter rainfall. As the plants become larger in succeeding years they exhaust the available moisture, and thus growth is slowed progressively earlier each year, leaving a longer period for rubber formation.

A very marked increase in rubber yield has been secured by selection of high-yielding varieties of guayule. The plants first brought under cultivation ranged, after five years growth, from less than one to over fifteen pounds in weight. All of the large plants were found to be low in rubber content. It is probable that most of the very large plants were progeny from crosses between guayule and *Mariola,* a related and associated plant with a 1 to 2% rubber content. Selection, mostly of medium-sized plants, and the building up of varieties in isolation has now established strains which consistently yield 20% rubber at the end of five years—an acreage yield of something just over a ton of rubber.

Guayule rubber, as extracted from the plant, is a highly resinous product. When deresinated, however, it is a good quality rubber.

Cryptostegia. Rubber from this genus was displayed at the Exposition of Madras in 1856. By crude native methods rubber was produced from *Cryptostegia* growing wild in both India and Madagascar during the nineteenth century.

Cryptostegia grandiflora, the palay rubber vine, was introduced into Mexico as an ornamental by a German sea captain. It spread rapidly in Mexico and then to Florida and the West Indies.

Cryptostegia madagascariensis, the Madagascar rubber vine, was introduced into Florida as an ornamental in the present century. In 1927 a natural hybrid between these two species was discovered in Florida. Detailed descriptions of these two species and the hybrid have been given by Polhamus, Hill and Elder (1934).

Cryptostegia is a much branched shrub or vine which under good conditions, particularly as to soil and moisture relations, makes rapid growth. The latex in *Cryptostegia* is in a latex tube system. It can be obtained by tipping the stems, or by chemical or mechanical extraction from the leaves and stems, though the latter has been done only in experimental studies and is not commercially practical. The rubber secured from stem tipping is superior to that extracted by other means but the yield per stem is extremely small and the amount of labor involved is tremendous.

Cryptostegia for rubber production has been planted over a large acreage in Haiti. The project, originally intended to contain 100,000 acres, is variously estimated as 40,000 to 43,000 acres at expiration of the planting deadline on March 31, 1944.

Goldenrod. The suggestion for the use of goldenrod as a source of rubber goes back to the work of the late Thomas A. Edison (Polhamus 1933). Edison directed a survey of some 17,000 samples of plant material from several different species native to this country. From this survey he decided that certain species of goldenrod represented the most promising plants for a possible development of domestic source of rubber which could be used during an emergency which cut off other rubber sources. At Mr. Edison's death his selected goldenrod material was turned over to the United States Department of Agriculture. Four species, *Solidago altissma, S. gigantea, S. leavenworthii,* and *S. sempervirens* were selected as the most promising.

In cultivation *Solidago leavenworthii,* native to Florida and extending North only to Georgia and South Carolina, has proved most satisfactory as to rubber yields. Selected strains of this species have given indicated yields of from 50 to 75 pounds of rubber per acre in the first year. These selected strains are propagated by stolon cuttings, a method which permits a very large annual expansion.

Limited to certain areas in the South, goldenrod has an advantage in that its soil requirements are not exacting. Average quality sandy loam "cotton land" is quite satisfactory.

At one time in the developmental program the goldenrod scab, caused by *Elsinoe solidaginsis,* presented a serious problem, but the better selected strains are almost completely immune. Goldenrod is harvested in the fall of the year by mowing and the leaves or the leaves and the stems are utilized for extraction of rubber. Extraction has been generally successful only by solvent processes. There is a possibility that the ligno-cellulose leaf residues, some carbohydrates and some proteins may provide by-products.

Taraxacum kok-saghyz, better known simply by its descriptive species name, which means "chew-root" in the Kazak language of its native habitat, is a comparatively new addition to the roster of potentially important rubber-bearing plants (Brandes 1942b). It was discovered in 1931 by a Russian expedition sent out to collect native Russian plants with a view to cultivating them as a nucleus of a domestic rubber supply. The plant was found at an altitude of 5,500 to 6,500 feet in soil designated as somewhat saline. Stands of about 5,000 acres were reported. The temperature of the region ranges, according to reports, from −2° F. to +59° F.

When grown under favorable conditions, kok-saghyz looks much like our

native dandelions. It is distinguished by the character of its involucral bracts and by the shape and size of the leaves.

The Russians began to cultivate kok-saghyz shortly after its discovery by the Ketman expedition. They achieved some considerable measure of success although its domestication in Russia, as in this country, has involved many problems.

A shipment of kok-saghyz seed arrived in this country in May 1942 and was distributed to various cooperating agencies and stations of the Bureau of Plant Industry for planting. Work of the last two years has indicated that kok-saghyz can be grown successfully in certain areas within this country and that with the solution of certain fundamental problems the plant would represent a valuable source of rubber.

As to its distribution it is now apparent that good growth of the plant in cultivation can be secured during the summer only in regions far enough north so that they do not have continued periods of exceedingly high temperatures. The best growth is of course in regions having relatively, not excessively, high day temperatures alternating with low night temperatures. Within this country the areas around Lake Champlain, in Northern Vermont, the Saginaw Bay area of Michigan, and the Red River Valley of Minnesota have been found to give very good results as to root growth. Best seed yields have been obtained at high elevations in intermountain Rocky Mountain valleys in Montana.

The Russians have reported 27 to 30 pounds per acre of seed as representing excellent yield. Montana yields are in excess of 150 pounds per acre. Some of the plants in that region have shown as many as 500 flowers during a season with as many as 100 in bloom at one time.

The problems incident to cultivating kok-saghyz include many of fundamental biological interest. Plantings grown from the seed which was imported from Russia contained plants ranging in rubber content from tenths of a percent to 16 or 18 percent, and in the case of some Canadian grown material up to 29 percent in the second year. Such a situation offers a tremendous opportunity for improvement by selection. Improvement by selection alone necessitates the building up of clones of the selected material by vegetative propagation.

Vegetative propagation of kok-saghyz has presented numerous problems for solution. Early experiments with root cuttings in the greenhouse tended to indicate that the matter of making root cuttings and growing plants from them was fairly simple. Attempts to repeat the procedures in the fields were very unsuccessful. Several factors now seem to be concerned. In the first place the amount of available stored nutrient material is a controlling factor. There is a wide variation in the amount of this material in different parts of the seasonal cycle. It now looks as though root cuttings would either have to

be made at certain specific times in the plants' growth cycle, or that roots would have to be stored at temperatures low enough to control the utilization of nutrient materials until the cuttings are made.

Kok-saghyz root segments are very strongly polarized with reference to the initiation of root primordia. As a result it seemed at first to be necessary to plant all the cuttings in their normal vertical positions. More recent work indicates that if the cuttings are placed horizontally, there occurs an apparent displacement of growth substances which induce the formation of many adventitious roots on the lower side of the cutting, and rapid rooting results. Many other problems, including that of disease control are involved in vegetative propagation.

Breeding work with kok-saghyz is complicated by the same factor which makes for the tremendous amount of heterogeneity in the populations. The plant is almost, if not completely, self-sterile. One would expect, of course, that a thorough study of populations would reveal the presence of a group of sterility factors operating in such a way as to isolate given genetic blocks of plants. There is some indication that this condition prevails. There is also a suggestion that there is a certain amount of self-fertility during particular periods of the blooming cycle. At any rate the populations are extremely heterozygous.

Two courses suggest themselves for obtaining more homozygous material. A search may reveal, as it has in many plants, certain individuals with a genetic factor for self-fertility. There is a possibility that such a factor could be combined with otherwise desirable characters. Another approach is to make crosses of such a nature as to put into the progeny a factor for apomixis which is common in other species of *Taraxacum*. Incidentally attempts at crossing *T. kok-saghyz* with other species of *Taraxacum* have brought out the fact that it is diploid while certain other species are tetraploid with respect to the basic chromosome number.

The chromosome number of *T. kok-saghyz* has been doubled by colchicine treatment and some apparently successful crosses between it and *Taraxacum megalorrhizon,* a species with a very high rubber content and some other desirable features, have been made.

Field cultivation of kok-saghyz presents another whole series of problems. First there is, at least in seed more than a few months old, a seed dormancy which must be overcome to secure uniform germination. Not surprisingly, in view of the heterogeneity of the seed stocks, germination of some seed takes place immediately, while that of others may be delayed for weeks or even months.

Planting of the seed in the field must be done with great care, particularly with reference to depth of planting in relation to the soil type. The young seedlings are extremely weak and will not emerge if any soil crusting takes

place. Once planted a serious problem arises from the fact that growth of the seedlings is so slow that weeding must ordinarily be done at least once before the seedlings are large enough to distinguish from weeds, or even up so as to permit detection of the rows. Attempts have been made to overcome this difficulty by using transplants and root cuttings. However, the solution probably lies in careful cultivation practices and the selection of more vigorous, more uniformly germinating stock.

Kok-saghyz is harvested by digging the roots after removal of the tops. The roots are then dried and the rubber is extracted by milling the dried roots. The extraction process is simple and inexpensive and the rubber obtained, according to all tests made to date, is of excellent quality, comparing favorably with good grade Hevea sheet.

The utilization of two by-products is possible. The roots contain at harvest time upwards of 8% inulin. The extraction and utilization of this carbohydrate will, according to Russian work, pay for the processing cost of the rubber. In addition 7 or 8% pectin is contained in the roots and its utilization has been suggested.

Other Plants. Many other plants yield rubber, some of them in appreciable amounts, but the ones mentioned seem to offer the only possibilities as rubber sources in the Western Hemisphere. Mention ought to be made, perhaps, of the fact that Russians have actually grown small plantings of certain species of *Scorzonera* for rubber production.

The Canadian Department of Agriculture is experimenting quite extensively with one of the milkweeds, *Asclepias syrica*. A suggested procedure here, however, is not to attempt to extract rubber itself, but to extract the rubber and resin compound from the leaves and utilize it as a combining agent with various synthetics.

Conclusions. It is perhaps of interest to attempt to gain as comprehensive a picture as possible of the parts played by this work on rubber plants in the present emergency and in the economic and social picture of the future. We were, at the end of 1941, cut off abruptly and almost completely from our source of a material which has come to play a very large part in our lives, both in war and in peace. We had on hand a rather limited supply of that material. The Rubber Conservation Program and the rapid and successful development of the synthetic rubber industry has turned the trick to the extent of preventing a complete breakdown in essential military and civilian transportation and in other processes so dependent upon rubber.

In 1941 it was imperative that we investigate all possible sources of natural rubber even though it was readily recognized that many of them could contribute very small amounts of rubber at a very high cost per pound. This was insurance against the possibility that for one reason or another the syn-

thetic rubber program might not be developed as rapidly and as well as it has.

In 1944 continued research on the minor rubber yielding crops is of importance—first, because some of them hold real potentialities for development as natural rubber sources, and because studies of all of them yield data which are of value in work on the more important ones. There is a considerable amount of controversy with reference to the performance of synthetics in automobile tires. There seems to be ready admission of the fact that in large bus and truck tires and those for military vehicles which must travel over very rough terrain, synthetic rubber is unsatisfactory unless it is combined with a large proportion of natural rubber and even then the product is not as good as a pure natural rubber tire. We have been using natural rubber from a stock pile which was none too large at the beginning of the war and which has been diminishing very rapidly.

In his last report the Rubber Director estimated that our imports of natural rubber during 1943 would total 60,000 tons.

Recent directives have been issued from the Office of the Rubber Director and the War Production Board further curtailing the use of natural rubber.

The manufacture of synthetics from petroleum products is based on the use of materials of which, even now, there are predictions of exhaustion of supplies. The manufacture of synthetics from alcohols involves growing plants for the production of carbohydrates, fermenting the carbohydrates, and then by complex processes producing a rubber substitute. Even if the synthetics prove to be as good as natural rubber this procedure must compete economically with a product formed directly by the plant.

Add to all of this the fact that consumption of rubber is undoubtedly going to increase very markedly after the war, when a tremendous deficiency of tires and other rubber articles will have to be filled, and there would seem every justification for very strong continued emphasis on the development of sources of natural rubber in the Western Hemisphere. Of these sources *Hevea brasiliensis* is most important and guayule has good possibilities. Kok-saghyz holds a potential rubber yield of perhaps 400 pounds per acre, the attainment of which presupposes the solution of several biological and production problems. It has the added feature of being the only crop from which good rubber can be obtained in a very short period.

Continued research on all of these crops is yielding valuable information, not only for rubber production, but for the production of other crops as well. In addition the development of the Hevea project is laying the basis for a more complementary trade with our Latin American neighbors after the war.

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Three New Saprophytic Chytrids

Anne M. Hanson

During a routine survey of fungi present in soil and water samples collected at Sharon, Connecticut, three new chytridiaceous species were discovered and isolated. The largest of these is eucarpic and polycentric, and resembles species of *Catenaria* in several characters, but differs fundamentally by the possession of operculate sporangia. Present studies indicate that it represents a new genus of operculate polycentric chytrids for which the name *Catenomyces* is hereby proposed.

Catenomyces gen. nov.—Thallo semper fere polycentrico, raro monocentrico, intramatricali atque extramatricali: parte intramatricali ramosa vel singula, septata; septis rudimenta sporangiorum vel isthmorum sterilium disiungentibus; parte extramatricali ramosa, non septata atque sterili. Sporangiis cum uno vel pluribus tubulis dimissionis, operculis sub obturamenta mucilaginosa evolventibus, Zoosporis a posteriore uniflagellatis. Sporis perdurantibus incompertis aut dubiis.

Catenomyces nov. gen.—Thallus usually polycentric, rarely monocentric, intra-and extramatrical; intramatrical portion branched or unbranched, septate; septa delimiting the rudiments of the sporangia or sterile isthmuses; extramatrical portion branched, aseptate and sterile. Sporangia with one to several exit tubes in which opercula develop beneath mucilaginous plugs. Zoospores posteriorly uniflagellate. Resting spores unknown or doubtful.

Catenomyces persicinus sp. nov.—Protoplasmate hypharum extramatricalium globulos aureos refractivos evolvente, protoplasmate hypharum extramatricalium hyalino manente. Zoosporangiis levibus, sporae plasmate maturitate persicino colorato, forma variabilibus, uteriformibus, 21-71 x 25-82 μ, pyriformibus, 12-45 x 19-82 μ, ovatis, 17-63 x 28-97 μ, cylindricis, 6-15 x 19-75 μ, sphaericis, 17-57 μ, ellipticis, 21-62 x 37-159 μ, orthogoniis, 43-55 x 59-83 μ, triangulis, 35-59 x 44-65 μ, vel irregularibus, 26-67 x 35-193 μ, cum 1-9 canalibus exeuntibus, 3.7-16 x 7.5-112 μ, aliquando ramosis, uno solo dehiscente. Apicibus papillarum vel canalium exeuntium maturitate mollescentibus, obturamento materiae mucilaginosae completis; protoplasmate deorsum recedente atque operculum sub obturamentum formante. Operculis maxime tenuibus, forma patellae similibus, rotundis vel ovatis, 2.2-2.9 μ, diametro. Zoosporis sphaericis, 3.7-4.5 μ, cum multis globulis aureis refractivis, flagello circiter 30 μ longitudine, singillatim emergentibus et cumulum ad tempus prope orificium formantibus, interdum amoeboideis. Sporis perdurantibus dubiis.

Catenomyces persicinus nov. sp.—Protoplasm of intramatrical hyphae developing golden refractive globules, while the protoplasm of the extramatrical hyphae remains hyaline. Zoosporangia smooth, with peach-colored spore plasm at maturity, variable in shape, uteriform, 21-71 x 25-82 μ, pyriform, 12-45 x 19-

82 μ, ovoid, 17-63 x 28-97 μ, cylindrical, 6-15 x 19-75 μ, spherical, 17-57 μ, elliptical, 21-62 x 37-159 μ, rectangular, 43-55 x 59-83 μ, triangular, 35-59 x 44-65μ, or irregular, 26-67 x 35-193 μ, with 1-9 exit canals, 3.7-16 x 7.5-112 μ, frequently branched, and of which only one functions. Tips of exit papillae or canals softening at maturity and becoming filled with a plug of mucilaginous material; granular protoplasm receding downward and forming an operculum beneath the plug. Opercula extremely thin, shallow saucer-shaped, circular or oval in outline, 2.2-2.9 μ, in diameter. Zoospores spherical, 3.7-4.5 μ, with many golden refractive globules, flagellum approximately 30 μ long, emerging singly and forming a temporary group near the orifice, intermittently amoeboid. Resting spores doubtful.

Saprophytic on grasses, bleached corn leaves, onion, and cellophane, Sharon, Connecticut.

The second species is monocentric and *Rhizophydium-like*. The sporangia and resting spores are surrounded by one or several hyaline zones or halos which stand out very sharply when stained with ruthenium red or gentian violet. The structure and development of this chytrid are fundamentally similar to those of species of *Rhizophydium*, and for this reason it is included in this genus under the name *R. coronum* nov. sp.

Rhizophydium coronum sp. nov.—Zoosporangiis hyalinis, sphaericis, 11-49 μ diametro, ovatis, 10-48 x 14-54 μ, cum muris laminatis, lamina externa saepe prope superior sporangi dirupta; una vel quinque papillis exeuntibus, 3-3.7 x 9-11 μ. Uno vel compluribus coronis concentricis sporangia evolventia circumdantibus, uno maturitate reliquo ante sporarum dimissionem plerumque deliquescente. Zoosporis hyalinis, sphaericis, 3.7-4.5 μ, cum uno magno globulo refractivo, 1.5 μ diametro, primis zoosporis cumulo emergentibus, post 6-14 horae sexagesimas partes devidentibus, reliquis in sporangio natantibus et singillatim emergentibus. Rhizoidibus mediocriter rigidis, cum 1.5-4.5 μ muris crassis, directis, tortuosis, minime vel maxime ramosis, uno saepe dominante atque maxime extenso usque ad 500 μ longitudine. Spora perdurante sphaerica vel subsphaerica, 22-35 μ diametro, cum muro lamellato sporangio simili, 0.7-1.3 μ crasso, pallido auro tincta. Spora perdurante unum vel plures magnos globulos medios strato, peripherali globulorum minorum circumdatos continente. Zoosporangio simili uno vel compluribus coronis involuta, atque germinatione prosporangi modo se gerente, zoosporangio hyalino 29-37 μ diametro oriente, quod deinde corono involvitur.

Rhizophydium coronum nov. sp.—Zoosporangia hyaline, spherical 11-49 μ in diameter, ovoid 10-48 x 14-54 μ, with laminated walls, outer lamina often disintegrating around the upper half of the sporangium; one to five exit papillae, 3-3.7 x 9-11 μ. One to several concentric halos surrounding the developing sporangia, reduced to one at maturity, which generally deliquesces before spore discharge begins. Zoospores hyaline, spherical, 3.7-4.5 μ, with one large refractive globule, 1.5 μ in diameter, the first zoospores emerging as a coherent mass, separating after 6-14 minutes, the remainder swimming in the sporangium

and emerging singly. Rhizoids fairly rigid, with 1.5-4.5 μ, thick walls, straight, coiled, sparingly or richly branched, one rhizoid often predominant and very prolonged, up to 500 μ in length. Resting spore spherical or sub-spherical, 22-35 μ in diameter, with a lamellated wall like that of the sporangium, 0.7-1.3 μ, thick, with a faint golden tint; contents of resting spore consisting of one or more large central globules surrounded by a peripheral layer of smaller globules; enveloped like the zoosporangium by one or several halos, acting like a prosporangium upon germination, giving rise to a hyaline zoosporangium 29-37 μ in diameter, which in turn is enveloped by a halo.

Saprophytic on grasses, bleached corn leaves, and cellophane, Sharon, Connecticut.

The third species belongs in the monotypic genus *Catenochytridium* and differs from the type species, *C. carolinianum,* by its smaller multiguttulate zoospores, by the asymetrical position of the sporangium and the presence of a predominant primary apophysis. Because of these differences it is regarded as a new species and given the name *C. laterale* nov. sp.

Catenochytrium laterale sp. nov.—Zoosporangiis hyalinis, levibus, ovatis, 16-46 x 21-62 μ, sphaericis, 12-44 μ, pyriformibus, 12-48 x 18-71 μ, cylindricis, 15-25 x 61-93 μ, atque intramatricalibus solis cum lobis, 28-63 x 88-160μ; operculo apicali, sub-apicali, laterali, 7.5-15 μ diametro, plerumque in sporangio vacuo persistente. Primaria cellula apophysidis semper dominante, sphaerica, ovata vel cum lobis, usque ad 27-30 μ diametro. Segmentis catenulatis apophysidis 1-7 numero, seriebus linearibus 1-4, primariae apophysidis cellulae a latere vel ab apice affixis ut inter primariam apophysidis cellulam atque sporangium emergant, raro ex radice primariae apophysidis cellulae emergentibus, saepe omnino deficientibus. Rhizoideo systemate (apophyside primaria addita) usque ad 224 μ magnitudine, minutissime ramificato, dichotomo. Zoosporis hyalinis, sphaericis, 2.9-4.5 μ, cum duobus, tribus, quattuor (raro uno), globulis refractivis; flagello 26-30 μ longitudine. Capsa zoosporae semper in zoosporangio persistente, crassa, bulbosa, numquam depressa, sucino vel atro-fusco colorata, raro apicali vel laterali, tuberculo simili in radice sporangi manente. Sporis perdurantibus non observatis.

Catenochytridium laterale nov. sp.—Zoosporangia hyaline, smooth, oval, 16-46 x 21-62 μ, spherical, 12-44 μ, pyriform, 12-48 x 18-71 μ, cylindrical, 15-25 x 61-93 μ, and lobed, 28-63 x 88-160 μ, when developed intramatrically; operculum apical, sub-apical, or lateral, 7.5-15 μ in diameter, generally persistent on the empty sporangium. Primary apophysate cell always predominant, spherical, ovoid, or lobed, up to 27-30 μ in diameter. Catenulate segments of the apophysis 1-7 in number, arranged in 1-4 linear series attached to the primary apophysate cell laterally or apically, so that they emerge between the primary apophysate cell and the sporangium, rarely emerging from the base of the primary apophysate cell, often completely lacking. Rhizoidal system (including primary apophysis) up to 224 μ in extent, becoming finely branched;

branching dichotomous. Zoospores hyaline, spherical, 2.9-4.5 μ, with two, three, four (rarely one), refractive globules; flagellum 26-30 μ long. Zoospore case always persistent on the zoosporangium, thickened, bulbous, never flattended, amber to dark brown in color, rarely apical or lateral, but remaining like a basal protuberance on the sporangium. Resting spores not observed.

Saprophytic on grasses, bleached corn leaves, onion, and cellophane, Sharon, Connecticut.

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Cuscuta japonica Choisy, an Asiatic Species New to America

T. G. Yuncker

The recent discovery of *Cuscuta japonica* in this country is an interesting instance of the distribution of a species of dodder far beyond its natural range. Only a few of the nearly 200 species of *Cuscuta* now known attack host plants of sufficient economic importance to make these parasites significant. But the wide range of distribution of such species makes the means of dissemination important.

Although it is conceivable for greenhouse and nursery plants to carry dodder infection, this mode of distribution is not probable because the parasite is sufficiently conspicuous to guarantee its elimination. Unusual extension of range is often, perhaps always, caused by the admixture of the dodder seeds with those of its host which are distributed for planting.

The North American *C. campestris* Yuncker thrives on leguminous hosts, especially species of *Trifolium*. Its seeds are often found mixed with those of its host and, consequently, it is found wherever such legumes are cultivated. The South American *C. suaveolens* Ser., which prefers alfalfa as a host, has been distributed in a like manner. Three European species have been widely disseminated in the same way. *C. Epilinum* Weihe which rarely occurs on hosts other than *Linum*, is to be found wherever flax is grown. *C. Epithymum* Murr. and *C. approximata* Bab. var. *urceolata* (Ktze.) Yuncker occur frequently on leguminous hosts and are widespread, especially on alfalfa and clovers.

Until recently, these latter four species—*C. suaveolens* from South America, and *C. Epilinum, C. Epithymum* and *C. approximata* var. *urceolata* from the Old World—have been the only foreign species of economic significance known to have been introduced into the United States.

In June 1941, R. F. Martin sent me a specimen of dodder, grown on kudzu (*Pueraria Thunbergiana* Benth.) in a greenhouse in San Antonio, Texas, which proved to be *C. japonica*. So far as known, this is the first species of Asiatic origin to be found in either of the American continents. Its discovery was reported in Lundell's Flora of Texas (**3**: 150. 1943). Finding this species in an American greenhouse was noteworthy but it was thought to be probably just a temporary introduction. The fact it was using an Asiatic hostplant would indicate that the dodder seeds were introduced with those of its host, as is usually the case with the species mentioned before.

In October, 1943, however, Erdman West of the University of Florida sent me a specimen which had been collected by J. D. Warner on a farm near Quincy, Gadsden County, Florida. This specimen, also growing on kudzu,

was also identified as *C. japonica*. When Mr. Warner was asked about the extent of the infestation, whether it had been noticed previously, etc., he stated: "It attracted attention for the first time this season (1943). However, I have no doubt but that it was there in previous years. The farmer piled brush on the fence where the dodder was found and burned brush, fence, kudzu and dodder. I doubt very seriously, however, if he will be successful in destroying all the seed."

A second letter received from Mr. Warner, May 16, 1944, states: "Recent observations reveal an outbreak of dodder in several new locations. Apparently kudzu is not the only host plant. Pokeweed seems to be a very acceptable host. I failed to find any dodder on kudzu or other native plants during the winter months and, therefore, presume the present outbreak came from seed."

C. japonica is a member of the subgenus Monogyna, which is characterized by having only one style in contrast to the two which are present in all species not belonging in this subgenus. The only American representative of this group is *C. exaltata* Engelm., a species found occasionally in Texas where it parasitizes ligneous hosts.

From Mr. Warner's observations it is apparent that *C. japonica* is able to utilize native American host plants and it would seem likely there are some which would prove acceptable to it. There is little doubt but that it would spread if allowed to become established in a favorable environment. Because of the possibility that this Asiatic species may be able to permanently establish itself as an undesirable alien in the American flora, it should be destroyed wherever found.

DePauw University
Greencastle, Indiana

REVIEWS

A Local Flora of Virginia

The vegetation and floristics of Bull Run Mountain, Virginia. By H. A. Allard and E. C. Leonard. Castanea 8: 1-64. 7 fig. (fig. 1, map). 1943.

The botanical investigation of the present United States began with the work of John Banister in Virginia about the year 1678 and reached its earliest peak in Gronovius' Flora Virginica (1739-43), which was based on the collections by John Clayton, mainly in Tidewater Virginia, and is the most important single source for the names of North American plants in Linnaeus' Species Plantarum of 1753. With the publication of Gronovius' flora systematic botanical investigations in Virginia practically ceased until near the end of the nineteenth century.

Small and Vail's report on a summer's investigation in the mountains of southwestern Virginia appeared in 1893-94, Kearney's report on the Dismal Swamp region in 1901, Murrill's alphabetically arranged list of the plants of Staunton in 1919, E. W. Erlanson's list of the flora of the peninsula of Virginia in 1925, Merriman's popular flora of Richmond in 1930, and Fosberg and Walker's list of the plants of Shenandoah National Park in 1941. The Committee on Flora of the Virginia Academy of Sciences was organized in 1926, and has done considerable local work; and in 1933 Fernald began the fruitful series of explorations of the coastal plain of Virginia which have added so many species to the flora of the Gray's Manual range. Despite this recent activity, Virginia is still one of the half dozen states for which no state list has ever been written, and until the publication of the paper here noticed it did not possess a single local flora based on sufficiently intensive and long-continued field work to justify its being regarded as essentially complete.

The area covered by Allard and Leonard's paper includes about 33 square miles of the Piedmont region in Loudoun, Fauquier, and Prince William Counties in northeastern Virginia, at an elevation of about 600 to 1300 feet, descending at the north and south ends to about 250 ft. It consists for the most part of steep ridges capped with quartzite and sandstones (Cambrian), separated by narrow valleys drained by cold brooks, with conglomerate bluffs along Broad Run and red sandstones, shales, and conglomerates (Triassic) toward the eastern edge of the area. Slightly more than half the territory is wooded, the remainder being devoted to cultivation or pasturage. There are few streams and no ponds.

The original (climax) forest of the highlands was composed principally of chestnut oak (*Quercus montana*) and chestnut, with red oak, sour gum, tulip-

tree, and hickory. The practically extinct chestnut is being largely replaced as a major member of the association by hickory (*Carya tomentosa*). The most conspicuous trees of the deciduous phase of the successional forest are black locust (*Robinia pseudo-acacia*) and tulip poplar (*Liriodendron*), and of the coniferous phase scrub pine (*Pinus virginiana*) and red cedar (*Juniperus virginiana* var. *crebra*). The heath flora is dominated by *Kalmia latifolia*. The shrub understory and ground herbage of the forest vary considerably in different habitats and with differences in the developmental state of the forest.

The annotated list of vascular plants, including 934 species (789 native) and 75 varieties, forms, and hybrids, is based almost entirely on 8 years of field work by the senior author at all seasons of the year. It is followed by statistics and a comparison of the generic coefficient with that of various other areas in the United States. This cofficient is nearly the same as that for the District of Columbia. The largest families are Compositae (124 species including introductions), Gramineae (97), Cyperaceae (68), Rosaceae (52), and Leguminosae (49), these 5 families comprising 41.7% of the total flora.

Altogether the work is a decidedly worth-while addition to the local floras of the United States.

S. F. Blake

Plant Exploration and Introduction
Bureau of Plant Industry, Soils, and Agricultural Engineering
Beltsville, Maryland

FIELD TRIPS OF THE CLUB

April 8. The New York Botanical Garden. The first trip of the 1944 season was a visit to the laboratory of Dr. William J. Robbins. Dr. Robbins explained that his was not a teaching laboratory nor a research laboratory in the ordinary sense but a laboratory for the investigation of certain vitamins and antibiotic substances. In both of these researches the unit of substance is very small, ordinarily the gama or microgram. We were then shown a reproduction of the sort of situation which Dr. Fleming observed and which started the investigation ultimately leading to the discovery of penicillin. A pure culture of *Penicillum notatum* was shown. The behavior of various bacteria in its presence was pointed out. Other fungi being tested for antibiotic substances were displayed. Dr. Robbins demonstrated the method of titrating the medium for potency after growing an organism in it.

Mrs. Annette Hervey demonstrated the use of an automatic pipette in transfering cultures aseptically. Dr. Roberta Ma conducted the group through the cold room where organisms are cultured at the constant tem-

perature best suited to their metabolism. Dr. Mary Bartley Schmitt then showed the group some of the most recently initiated investigations dealing with the response of certain Phycomycetes to modified nutrient media.

Dr. Robbins' assistants were most generous in remaining for a prolonged question period. Attendance 26.

April 16. Southfields, N. Y. No one appeared, presumably due to the heavy rain. Leader, Mr. G. G. Nearing.

April 23. "Pine Barrens Island," New Brunswick, N. J. This trip was held in the rain. A particular search for lichens failed to produce much of a list. The following plants ordinarily associated wih the pine barrens were seen: *Pinus rigida, Quercus marilandica, Q. ilicifolia, Kalmia augustifolia, Salix tristis, Pyxidanthera barbulata, Epigaea repens,* and *Pteridium latiusculum*. The stand of Helonias was not far enough advanced to warrant the walk necessary to reach it. Leader, Dr. John A. Small. Attendance 7.

April 30. Franklin Township, Somerset Co., N. J. The morning was spent in Mettlar's woods, where a fine stand of oak-hickory forest was observed. Mature specimens of many of the tree species were found. After lunch the group moved on to the vicinity of Raritan, N. J., to see a stream bank forest along the Raritan river. The alluvial soil of this locality (Bermudian silt loam) supports a great variety of trees, shrubs, and ground plants. The most conspicuous ground plants at the time were *Mertensia virginica, Dentaria laciniata,* and *Claytonia virginica* with a host of less abundant species. A list of over 70 species has been prepared from the small area that is an island at high water stages of the river. Leader, Dr. John A. Small. Attendance 12.

May 6. Brooklyn Botanic Garden. A walk through the Local Flora Section (Wild Flower Garden) was very instructive and pleasant. Some of the problems of establishing and maintaining ecological conditions to reproduce various habitats from within the Torrey Range were described. Everyone pronounced the results most successful. Leader, Dr. H. K. Svenson. Attendance 10.

May 7. Watchung Reservation, Union County, N. J. The Club served as scientific host for the opening of Trailside Museum for the 1944 season. Despite the continuous rain, two walks were held for those interested. Some half-dozen local nature clubs were represented by their officers. The Club was represented through its field committee by the chairman, Mr. G. G. Naring, and Miss Farida Wiley. A considerable display of local flora, fauna, and minerals is maintained during the season. The museum will be open Sundays through October. Our leader, Miss Nellie Louise Condon gave an

instructive talk about reptiles, illustrating it with living specimens. Attendance was about 60.

MAY 13. BROOKLYN BOTANIC GARDEN. A walk to see species and varieties of lilacs was led by Dr. Alfred Gundersen, who repored, "Weather and lilacs perfect. Among those seen in fine condition were Vestale, Lucie Baltet, Rochambeau, Mrs. W. E. Marshall, Waldeck-Rousseau, Paul Thirion, Marshal Foch, and *Syringa chinensis*." Attendance 7.

MAY 13-14. CAMP THENDARA. The joint outing with the New York Section of the Green Mountain Club at their camp on Lake Tiorati in the Harriman Section of Palisades Interstate Park was delightful, and the weather perfect. An annual bird census, made under the guidance of Professor Julius Johnson, listed 61 birds. Leader, Mrs. Laura Woodward Abbott. Attendance 28.

PROCEEDINGS OF THE CLUB

MINUTES OF THE MEETING OF FEBRUARY 16, 1944

The meeting was called to order at 3:30 p.m. by Dr. F. J. Seaver, First Vice-President, at the Brooklyn Botanic Garden. Thirty-six members and guests were present. The minutes of the preceding meeting were accepted as read. Since there was no further business, the meeting was devoted to the scientific program.

Mr. Montague Free of the Brooklyn Botanic Garden spoke on plant propagation. He discussed in detail such topics as seed germination, rooting from cuttings, and grafting. Each of these subjects was illustrated with plants growing in the conservatories of the Brooklyn Garden. Using various shrubs and trees, Mr. Free deftly demonstrated the common types of grafting. He displayed several intergrafts that had previously been made, such as Christmas cactus on the stock of *Pereskiopsis*. Mr. Free's talk was followed by considerable discussion of the topics that he had interestingly presented.

Dr. Henry K. Svenson of the Brooklyn Botanic Garden gave the next report entitled "Through the Flowering Season at the Brooklyn Botanic Garden." The speaker's abstract follows:

A series of Kodachrome pictures showing progress of the seasons from winter time to the displays of snowdrops, crocus, magnolia, and daffodils in the early spring. Next, about the second week in May, comes the extensive display of flowering cherries and crabapples (the most popular of all), and in the Local Flora area, the trilliums, violets, and other native plants. By June the rose garden and the irises are in full bloom. Later come the various lilacs and the midsummer plants in the herbaceous beds in the Systematic Section. In the fall the asters and goldenrods of the Local Flora area are especially noteworthy.

These are followed by the exhibits of variously-colored chrysanthemums, both out-of-doors and in the greenhouses.

Informal discussion continued, stimulated by the Epicurean delights generously provided by the Brooklyn Botanic Garden.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of March 7, 1944

The meeting was called to order at 8:15 p.m. by President Levine in Schermerhorn Hall, Columbia University. Twenty-five members and friends were present.

The minutes of the preceding meeting were approved as read. Five persons were unanimously elected to annual membership, and one resignation was accepted with regret.

The scientific program of the meeting was presented by Dr. M. A. Chrysler of Rutgers University, his subject being "The Evolution in the Fern Genus, *Gleichenia*: a Field and Laboratory Study." The speaker's abstract follows:

The growth habit of the tropical fern genus *Gleichenia* was illustrated. The apparent dichotomy exhibited by the leaf is now regarded as a sympodium.

At least four sub-genera, or probably genera, have been distinguished by external characters. The possibility of distinguishing these groups on the basis of structure of the petiolar bundle was examined. The simplest condition is found in the leaf-trace of certain species of *Stichcrus,* e.g. *S. Intermedius.* In this group the bundle in cross section has the form of a "C." *Hicriopteris* shows adaptation to the large size characteristic of the group, but the bundle is still C-formed. In *Dicranopteris* the bundle is laterally compressed so as to be deltoid in form, and is more specialized in details. The species *D. pectinata* has a stipe bundle much like the preceding, but its stem is unique in having a solenostele. Finally the Old World *Eugleichenia* has the most highly specialized bundle, showing a nearly circular outline with accumulations of xylem at two regions.

Interesting intermediate forms of bundle occur, probably representing evolutionary stages. The proposed arrangement of genera may be represented in a simple genealogical tree.

After discussion of the paper, the meeting was adjourned at 9.30 p.m.

Respectfully submitted,

Honor Hollinghurst
Recording Secretary

Minutes of the Meeting of March 15, 1944

The Torrey Botanical Club met on March 15 in Larkin hall of Fordham University as guests of the Fordham Botany Department. Before the meeting began, tea and refreshments were served by members of the staff.

The meeting was called to order at 4:40 p.m. by President Levine. Forty-five members and friends were present. The minutes of the preceding meeting were approved as read.

The scientific talk was presented by Father Berger, who discussed "Experimental Studies on the Cytology of *Allium*" illustrating his talk with charts and slides. The abstract of the paper follows:

Root tips of *Allium cepa* were treated with the following chemical agents: colchicine, acenaphthene, veratrine, sulfanilamide, chloral hydrate, benzene, oxygen lack and alpha-naphthalene-acetic acid. The cytological effects of these treatments were noted and compared with the well known colchicine effects. The results are summarized in the following chart.

	Effect on Mitosis in Allium				
Treatment	Delayed div. of SA-region	Diplo-chromosomes	Inhibition of spindle	Polyploid cells	Polyploid mitosis
Colchicine	++	++	+	+	+
Acenaphthene	++	++	++	++	+
Veratrine	+	+	+	+	++
Sulfanilamide	+	+	+	+	+
Chloral hydrate	+ slight	+ long	++	+	+
Benzene	+	+	++	+	
Oxygen lack	slight	poorly developed	+	+	
Naphthalene-acetic acid ..... meristem	—	—	—	—	—
reg. of elongt.		tetra-chromosomes	—	+	++

The first seven agents all induced polyploidy and produced the same type of cytological effects in spite of the great difference in their molecular structure. The tentative conclusion was drawn that the chief effects are not specific to the particular chemical agents but are general effects common to all the substances in question and interfering with some metabolic process concerned with the formation of the spindle and the division of the SA-region. Benzene has the added property of rendering the structure of prophase chromosomes exceptionally clear so that half chromatids can readily be seen.

Naphthalene-acetic acid differs from all the other agents used in that it has no effect on the formation of a spindle. It produces polyploid cells by an entirely different process. There is no effect on the meristem but differentiated cells of the cortex undergo a double reproduction of their chromosomes in the resting stage. At metaphase tetrachromosomes are formed and two successive divisions of the SA-regions occur.

After a general discussion of the paper, the meeting was adjourned at 5:50 p.m. to permit the audience to inspect the microscopic mounts showing the cytological effects discussed by Father Berger.

Respectfully submitted,

Honor M. Hollinghurst
Recording Secretary

Minutes of the Meeting of April 4, 1944

The meeting was called to order at 8:20 p.m. by President Levine in Room 603 of Schermerhorn Hall, Columbia University. Eighteen members and friends were present. The minutes of the preceding meeting were accepted as read.

Dr. Levine introduced the speaker, Professor George H. Shull, whose subject was "Some Genetical Studies with *Capsella*." Dr. Schull discussed the results of his investigations into the various aspects of the genetics of this genus and suggested some problems still to be solved. The talk was illustrated with lantern slides.

Following discussion of the paper, the meeting adjourned at 9:45 p.m.

Respectfully submitted,

Honor M. Hollinghurst
Recording Secretary

Minutes of the Meeting of April 19, 1944

The meeting was called to order at 3:30 p.m. by President Levine in the Members' Room of The New York Botanical Garden. Twenty-five members and guests were present. The minutes of the preceding meeting were accepted as read.

The scientific program consisted of a talk by Mr. Jerome Metzner on "The Morphology, Cytology and Taxonomy of *Volvox*," which was illustrated with lantern slides. The speaker's abstract follows:

Although *Volvox* has been investigated frequently since its discovery by Leeuwenhoek (1719), many gaps in our knowledge of it remain. The phenomenon of inversion discovered by Kuschakewitsch (1922) has been worked out in detail by Pocock (1933, 1938) for certain African species of *Volvox*. Zimmerman (1921) has published the only detailed study of mitosis and meiosis in a species of *Volvox—V. aureus*. Fertilization has never been observed in any species of *Volvox* although some workers have presented evidence that it does occur. Other workers have shown that some of the eggs of *Volvox* develop parthenogenetically. It has been shown (Uspenski, 1925) that *V. aureus* and *V. globator* have a high iron nutritional requirement and that these species can be maintained successfully in laboratory cultures if regular additions of iron salts are made to the culture medium.

V. Carteri var. *Hazeni* is a new variety of this species which is closely related to the European species *V. tertius*. Asexual reproduction is accomplished characteristically by the production of eight daughter colonies in which the reproductive cells are differentiated at about the 64-celled stage. In sexual reproduction this species is heterothallic. Female colonies produce 18-20 eggs. Male colonies are dwarf and produce about 50 bundles of spermatozoids. It seems probable that a large number of eggs develop parthenogenetically. About 90% germination was secured in oospore germination experiments. It was possible to secure germination of oospores within 10 days after their release from a female colony.

Germination of the oospere results in the formation of an aplanospore or biflagellate zoospore. Either product undergoes successive divisions to form a young colony which inverts to form a juvenile colony. This gives rise asexually to normal Volvox colonies. Mitotic division is of the type generally found among the protista. A resting nucleus of a cell in a developing daughter colony contains a large Feulgen positive endosome, a smaller Fuelgen negative plasmosome and a linin reticulum with chromatic granules scattered through it. In prophase the plasmosome disappears and endosomal division results in the formation of two polar endosomal masses which undergo chemical changes while being extruded through the nuclear membrane into the cytoplasm. Intranuclear endosomal masses are Feulgen positive whereas after extrusion they are Feulgen negative. It is suggested that there is a flow or nucleic acids from nucleus to cytoplasm wherein the desoxyribose nucleic acid derived from the endosome becomes converted to cytoplasmic ribonucleic acid. In metaphase the chromosomes are tiny and closely associated and the endosomal masses have almost completely disappeared. The anaphases occur quickly and in telophase aggregation of chromatic material results in the reformation of the endosome; in addition the plasmosome reappears. Mitosis is intranuclear. Cytokinesis is achieved by constriction of the protoplast between the daughter nuclei.

A revision of the section Merrillosphaera of the genus *Volvox* is suggested in which the species *V. mononae* Smith is abandoned and *V. Migula* (Shaw) Printz is incorporated within another species. It is also suggested that the section Campbellosphaera be abandoned and the form *Campbellosphaera obversa* be named *Volvox Carteri* var. *homothallicus*.

The interest of the audience was attested by the animated discussion which took place upon the conclusion of Mr. Metzner's presentation. The meeting adjourned at 4:50 p.m.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of May 2, 1944

The meeting, which was held at Hunter College, was called to order at 8:15 p.m. by President Levine. There were 80 members and guests present. The minutes of the preceding meeting were approved as read.

Dr. Matzke was asked to read the following communication from the Committee on the C. Stuart Gager Memorial of the Brooklyn Institute of Arts and Sciences:

Last August, in the death of Dr. C. Stuart Gager, the world lost an eminent scientist, the Brooklyn Botanic Garden a great curator and administrator, and all who love horticulture a staunch and loyal friend.

The Brooklyn Botanic Garden has become a place of great interest largely through his vision and continued efforts, carried on over a period of thirty-three years. Its beauty is a constant source of delight to thousands of visitors each year. The adult classes in gardening, the lectures on horticulture, the instruction given to children, have blazed a new trail in botanic activities and the lives of many people have been broadened and enriched by the program which Dr. Gager conceived, organized and administered.

Dr. Gager's name should always be remembered with appreciation and gratitude. It is fitting that those who knew his work should want to provide a lasting memorial, which would remind the on-coming generation of the debt that all lovers of beauty owe to him.

With this in view, the Trustees of the Brooklyn Institute of Arts and Sciences have authorized a "C. Stuart Gager Memorial Fund" to be raised by voluntary subscriptions. The memorial selected will be determined by the size of the fund available, and will be something truly commemorative of Dr. Gager and of his life work.

It seems clear that many friends of the Garden and admirers of Dr. Gager and his work will wish to contribute to a Fund for this purpose. If you are one of those who believe in such recognition for notable contribution to the community, and wish to help toward that end, please send your check to the Brooklyn Botanic Garden, 1000 Washington Avenue, drawn to the order of the "C. Stuart Gager Memorial Fund."

It will be especially helpful if this may be done promptly.

The scientific program of the meeting was presented by Mr. Rutherford Platt. The subject of Mr. Platt's talk was "The Mechanics of Spring." The speaker's abstract follows:

"The Mechanics of Spring" touched the high spots of events from the flowing of maple sap to the visits of insects to flowers. The Kodachromes showed details taken through a magnifying lens.

Mr. Platt's viewpoint was that of the mechanics of plant life. In his introduction he remarked that the landscape never stands still. In a broad categorical sense, the most conspicuous mechanical operation in spring is that of opening buds. In summer it is the way flowers behave when insects visit them; in fall and winter it is the opening of seed cases and ejection and dissemination of seeds.

Pictures showed examples of phyllotaxy: conduplicate, plicate, circinate, convolute, involute. Then followed the operation of bud scales and the various ways the contents emerge. Particularly vivid were the pictures of hardwood flowers. Those of elm and oak showed pollen ejected. The talk closed with illustrations of what happens when butterflies and bees visit various wild flowers. Although not using movies, Mr. Platt showed pictures in sequence using stills with lapsed time.

At the conclusion of Mr. Platt's most interesting talk, President Levine announced that the meeting would be adjourned so that the Club would have an opportunity to talk informally with Mr. Platt and to visit the laboratories and greenhouse of the Biology Department of Hunter College. Tea and refreshments were served by members of the College faculty.

Respectfully submitted,

Honor M. Hollinghurst
Recording Secretary

THE TORREY BOTANICAL CLUB

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OTHER PUBLICATIONS

OF THE

TORREY BOTANICAL CLUB

(1) BULLETIN

A journal devoted to general botany, established in 1870 and published bi-monthly at present. Vol. 70, published in 1943, contained 676 pages and 5 plates. Price $6.00 per annum. For Europe, $6.25.

In addition to papers giving the results of research, each issue contains the INDEX TO AMERICAN BOTANICAL LITERATURE—a very comprehensive bibliography of current publications in American botany. Many workers find this an extremely valuable feature of the BULLETIN.

Of former volumes, 24-70 can be supplied separately at $6.00 each; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Single copies ($1.00) will be furnished only when not breaking complete volumes.

(2) MEMOIRS

THE MEMOIRS, established 1889, are published at irregular intervals. Volumes 1-19 are now completed. Volume 17, containing Proceedings of the Semi-Centennial Anniversary of the Club, 490 pages, was issued in 1918, price $5.00.

Volume 19, no. 1, 92 pages, 1937, price $1.50. Volume 19, no. 2, 178 pages, 1938, price $2.00. Volume 19, no. 3, 76 pages, 1940, price $1.25. Volume 19, no. 4, 58 pages, 1941. Volume 19 complete, price $5.00.

Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

Reprinted monthly on cards, and furnished to subscribers at three cents a card.

Correspondence relating to the above publications should be addressed to

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New York 27, N. Y.

Volume 44 December 1944 Number 3

TORREYA

EDITED FOR
THE TORREY BOTANICAL CLUB
BY
HAROLD H. CLUM

John Torrey, 1796-1873

CONTENTS

Inactivation of Incompatibilities in Tetraploid Progenies of Petunia axillaris ..... A. B. Stout 45

On the Shoot Apex of the Cycads ..... Marion A. Johnson 52

New Plant Records for the Niagara Frontier ..... Irving W. Knobloch 59

Observations on the Distribution of some Aquatic Plants in Guatemala ..... W. C. Muenscher 61

Damage to Trees in New York City in the Hurricane of September 14, 1944 ..... Arthur Harmount Graves 66

Notes on Spergularia ..... Myron Arthur Rice 74

Proceedings of the Club 76

News Notes 78

Index to Torreya, Volume 44 79

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THE TORREY BOTANICAL CLUB

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TORREYA

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Inactivation of Incompatibilities in Tetraploid Progenies of Petunia axillaris[1]

A. B. STOUT

During the past five years the writer and his assistants[2] have carried on a series of investigations to obtain direct experimental data from diploid and derived autotetraploid progenies of *Petunia axillaris* on the effect which autotetraploidy has on the heredity and expression of self- and cross-incompatibilities.

Two (6, 9) preliminary reports of these studies were made in 1941 and 1942. Since then further cultures have been studied especially in regard to the inter-group relations between the 2n and the 4n populations. The results obtained to date on these matters may be summarized as follows:

INTRA-SPECIFIC REPRODUCTION OF DIPLOID (2n = 14) *Petunia axillaris* (Lam.) B. S. P. (*P. nyctaginiflora* Juss.)

Of this species 23 plants grown from seed obtained from Argentina and also various further pedigreed seed progenies were remarkably uniform in character and especially in the homomorphic differentiations of sexuality in the hermaphrodite flowers. These features of fundamental specificity may be represented as **AA**. Were it not for the special factors of incompatibility this fundamental specificity would give complete intra-specific reproduction.

But fully adequate tests revealed that each individual of the entire population which was studied, including successive generations, was self-incompatible and that there were also cross-incompatibilities which operate in the simplest type (the "personate" type) of intra-specific-incompatibilities known in hermaphrodite flowering plants (4). The special incompatibility factors (*"S"* factors) exist in addition to the constitutional sexuality of specificity (**AA** + $S_x S_y$). These factors are self-interacting in the physiological reactions of haploid pollen tubes and diploid styles both in self-pollination and in cross-pollination. For a plant (**AA** + $S_x S_y$) there is incompatible reaction for both

[1] Presented in greater detail at the meeting of the Torrey Botanical Club on May 17, 1944 at The New York Botanical Garden.

[2] Before July 1943 Dr. Clyde Chandler was technical assistant to the writer in these studies and since that date Miss Anita Appel has had this position. Most of the routine pollinations and all of the technical laboratory studies of this research have been done by them.

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classes of its pollen. Also two plants of the same genotype are cross-incompatible. When two plants possess *one* factor in common (**AA** + S_1 S_2 × **AA** — S_1 S_3) there is incompatible elimination of fertilization for the pollen which carries that factor. But when there is no common *S* factor (**AA** — S_1 S_2 × **AA** + S_3 S_4) there is no incompatible reaction and the two individuals cooperate fully in reproduction as do any two members of a species or group that possesses no incompatibility factors. In the 23 plants grown from seed from Argentina there were 12 different genotypes of from one to three individuals for which there was inter-genotypic cross-reproduction.

Auto-tetraploids of *Petunia axillaris* and their Intra-group Reproduction

Induced auto-tetraploids were readily obtained by spraying buds of young seedlings of diploid (2n = 14) *P. axillaris* with solutions containing colchicine. From one to three lateral branches which were 4n were obtained on fifteen different seedlings which were otherwise 2n. These seedlings were of several genotypes in regard to *S* factors.

There was complete inhibition of the reaction of self-incompatibilities in the flowers of all 4n branches. The self-pollinated flowers of 4n branches produced large capsules well filled with many viable seeds while the flowers of diploid branches remained fully self-incompatible. (See figure 1.)

This inactivation of incompatibility factors was inherited in seedling offspring. Seed progenies of selfed flowers of 4n branches were grown for six different plants and the total of such seedlings was 212. Another seed generation, the second for the generations of induced tetraploids, totaling 86 individuals, is now in heavy bloom. Every plant of these progenies was tetraploid. Every seedling produced large capsules and many viable seeds to normal self-pollination. Several thousand of the cross-relations between tetraploid plants (intra-series, inter-series, 4n parents and 4n progeny, etc.) were tested by controlled pollinations. Every one of these intra-tetraploid cross-relations resulted in capsules and many viable seeds.

Evidently in these tetraploids only microspores and macrospores which possess two genomes function in the intra-group fertilizations and seed reproduction. Thus the inactivation of self- and cross-incompatibilities which arose as a discontinuous condition in induced 4n branches is hereditary on the selfed offspring, which have also been 4n.

Inter-Group Relations between the 2n and the 4n Groups of *Petunia axillaris*

In the report of 1942 (9) it was stated that in the reactions of fertilization the tetraploid × diploid relation for the tests made entirely failed to produce

even rudimentary capsules while the reciprocal relation of 2n × 4n resulted in large capsules and many seed. But it may now be stated that of several seed plantings involving large numbers of these seeds not one seed has germinated and also that all of these seeds thus far examined have been without embryos. There is therefore not a one-way inter-fertility or "compatibility" but an inter-group sterility barrier between 2n plants and their derived 4n plants that is of a status already well known for 2n populations of certain species, in which there are no self- and cross-incompatibilities, and the derived 4n. That this

FIGURE 1. Typical plants grown from seeds and of same age from seed planting; in 7 inch pots. At left, self-incompatible diploid plants of *Petunia axillaris*. At right, 4n *P. axillaris* of the second generation after induced autotetraploidy. The two large capsules shown against the inserted card are such as are obtained to all self- and intra-cross pollinations of the 4n population.

barrier extends to all 2n and 4n genotypes of the entire species is, of course, not determined and there is some evidence that it may not do so when distinctly different genotypes are involved.

The Status of Spore Abortions in Hybridity and Autopolyploidy

An adequate review of the several distinctly different types of sterility which operate in amphiploidy and autoploidy is not possible at this time. It should be noted that much attention has been given to the fact that when branches or seedlings of "sterile" F_1 hybrids become tetraploid the flowers of such amphiploids may be highly "fertile." But in these cases the sterility involves abortion of spores and pertains to the total potential ability of individuals to function *in any relation* in seed reproduction. This is entirely distinct from the intra-specific (or intra-group) self- and cross-incompatibilities and also from the inter-specific barriers to hybridizing fertilizations. But abortion of spores and abortion of seeds may be features either (a) of inter-specific barriers which operate after successful fertilization has produced a hybrid progeny, or (b) of the irregularities of sporogenesis in both F_1 hybrids and pure autoploids.

Inter-specificity for 2n and 4n Populations when there are no Intra-Incompatibilities

That there may be the operation of a sterility barrier between closely related 2n and 4n populations in various cases in which there are no self- and cross-incompatibilities has been well established. Müntzing in 1936 (3) presented an extensive survey of the data on this matter and concluded that a purely quantitative chromosome doubling often results in structural and physiological changes in specificity and that different chromosome races of a single species, including experimental autoploids, are generally separated from each other by barriers of "incompatibility and sterility." But Müntzing uses the term "incompatibility" for the inter-relations *between* entire species or groups of individuals and he does not mention any behavior of intra self- and cross-incompatibilities though they are known in some of the 2n species which he surveys. It must be stated and perhaps emphasized that self- and cross-incompatibilities are not necessarily absent or inactive in tetraploid species. Among well established natural species they may be present or absent either in species of low chromosome number or in species that are evidently polyploid, even in the same genus.

Data for Experimental Auto-tetraploids Derived from 2n Plants which have incompatibility factors

There are somewhat meagre data on the behavior of incompatibilities in autotetraploids definitely known to have arisen from diploids in which self-

and cross-incompatibilities operate. Often the data given are confined to "Self-sterility" and are indefinite, incomplete and to some extent inaccurate in this matter. Especially is this the case for the petunias.

Lewis and Modlibowska (8) consider that certain tetraploid "systematic species" (possibly some are clones) that are "self-compatible" may have arisen from 2n "self-sterile" plants of *Allium, Tulipa, Hyacinthus* and *Prunus.*

Of the more reliable data for experimental autotetraploids there is one statement (8) that self-incompatibility continues to operate in derived seedling autotetraploids of *Oenothera organensis,* and a report (10) with data that both self- and cross-incompatibilities operate in a tetraploid seed progeny derived experimentally from 2n plants of *Oenothera rhombipetala Bridgeport.*

There is one case reported which corresponds, in part at least, to the relationships here presented for the diploid and the autotetraploid *Petunia axillaris.* The 2n clone of the cultivated pear, Fertility, has been described as "only slightly self-fertile" (5) and as able to produce a good crop of seedless parthenocarpic fruits (7). A 4n clone named "Improved Fertility" that arose as a somatic bud-sport from Fertility was found to be definitely "more self-fertile" than the 2n type (5, 7), able to set a full crop of fruit and seed to its own pollen, and "fully self-compatible" (8). For the inter-relations in reproduction, the 4n clone Improved Fertility $\times$ the 2n clone produced no fruits (45 flowers were pollinated) but for the 2n clone $\times$ the 4n clone "a full set of fruits and seeds is obtained" (7, 8).

The intra-clonal and the inter-clonal relations in fertilization of the 2n pear, Fertility, and its 4n bud-sport seem to be like those of the 2n and 4n branches of each of the 15 original plants of *Petunia axillaris* which were treated with colchicine. But further similarities are not so evident. In *Petunia axillaris* the seeds of 2n $\times$ 4n are not, it now appears, viable; in the cultivated pears the seeds derived from 2n $\times$ 4n (see text—figure 1 and table 3 of 7) are, it seems, highly viable. The 4n Improved Fertility $\times$ five diploid clones other than Fertility was highly fertile in terms of fruit and seed production to two clones, much less so as to two other clones, and fruitless to one clone. The clones of pears correspond to individual seedlings of a species which may differ in genotypic constitution.

Diversity in Constitution

Much remains to be learned regarding the diversity in the behavior of self- and cross-incompatibilities in experimentally produced tetraploids. Incompatibilities both self and cross are extremely diverse in character, expression, and genetical nature (4). Uniform results can not be expected for all the diverse types especially when the simpler "personate type" is compared with the complex associate type, and when amphiploidy is involved. It is well established (4) that some of both the diploid and polyploid hybrid cultivated

races of *Petunia* have complex polygenic and heterogenic heredity of the intra-race self- and cross-incompatibilities. Also in the constitution of both the 2n and the 4n varieties of hybrid origin in Petunias there are both qualitative and quantitative differences in the recombinations of genes, chromosomes, and genomes which determine the specificity in the diverse parental species. No doubt these may determine further inter-relations on other than a purely quantitative 2n and 4n relation. Tjebbes (1) reports he obtained few seed and only weak seedlings in reciprocal inter-crosses between 2n *"P. nyctaginiflora"* (*P. axillaris*) and two 4n cultivated races. Steere (2) made inter-pollinations between a pure race of *P. axillaris* and 4n cultivated races. To some he obtained little seed of which none germinated. But one race having strongly colored flowers and blue pollen (characters of the *P. violacea*) was highly cross-fertile especially when it was the pollen parent.

Summation for *Petunia axillaris*

For the cultures of *Petunia axillaris* here reported the quantitative doubling of each of the genomes in diploid plants results in two profound, different, and discontinuous changes in the reactions of reproduction.

1. The two closely related populations, one diploid and the other derived tetraploid, exhibit an inter-group sterility barrier. The 4n $\times$ 2n gives no capsules; the 2n $\times$ 4n gives capsules with seeds that are empty and not viable. The 4n gains a specificity status similar to that of the 4n and the 2n when there are no incompatibilities and similar to that of certain well-established natural species.

2. In the 4n intra-relations there is inactivation of the secondary *S* factors which operate effectively in the 2n. Thus the 4n population gains an intra-group reproduction that is complete for the self- and intra-cross relations between members.

New York Botanical Garden

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On the Shoot Apex of the Cycads*

Marion A. Johnson

The structure of the shoot apex has been and is being widely studied because of its bearing on growth and ultimate origin of the organs and tissues of the shoot. The pioneer investigators in this field traced cell lineage from the base of the shoot apex to the summit as a converging cellular network. Unfortunately both botanists and zoologists thought that the tissues in widely divergent groups could be derived from identically placed apical cells, histogens, or germ layers, as the case might be. Accordingly several theories were proposed to account for cellular configuration and growth in the shoot apex of seed plants. The discovery and wide-spread occurrence of an apical cell in bryophytes and pteridophytes, together with the histologic technique of the times, led several investigators to portray apical cells in both gymnosperms and angiosperms. Subsequent studies, particularly those of Hanstein (1868), revealed the shoot apex as containing the three familiar histogens: dermatogen, periblem and plerome, each of which was perpetuated by a series of superimposed initials. The dermatogen, a uniseriate layer, produced the epidermal system, the periblem of one or more layers, the cortex, and the plerome, the procambium and pith. More recently Schmidt (1924) has interpreted the shoot apex in certain dicotyledons (the theory has been extended to include certain grasses, gymnosperms and species of Lycopodium) as comprised of two zones. The outer, *tunica,* consists of one or more cell layers in which division is periclinal and which as a consequence is characterized by surface growth. The inner zone, *corpus,* is characterized on the other hand by division in all planes and by increase in volume. Still other investigators have considered the shoot apex to be occupied by a primordial meristem characterized by a homogeneous, simple, undifferentiated structure. Further details concerning these theories will be found in two critical surveys by Foster (1939a, 1941a).

The shoot apex in the cycads is of particular interest because its structure can not be interpreted by these proposals and, furthermore, comparative studies of the shoot apex must of necessity include the cycads because of their low position among living seed plants. Representatives from seven of the nine genera have been studied recently. Foster (1939b, 1940, 1941b, 1943) has described and illustrated the structure in *Cycas, Dioon* and *Microcycas* while Johnson (1939, 1944) has investigated *Zamia, Encephalartos, Bowenia* and *Macrozamia.*

Material of *Zamia* may be grown easily from seed or obtained from plants growing in the field in southern Florida. Two-year old plants of *Cycas revoluta*

*Presented in greater detail at the meeting of the Torrey Botanical Club on May 17, 1944 at The New York Botanical Garden.

or lateral buds which are fairly common on large plants make excellent subjects for study. Fortunate indeed is the botanist who can secure the tip of a really old plant which must be sacrificed for want of space or other reason. Greater difficulty will be experienced in obtaining material from the remaining genera. *Zamia* and *Cycas*, however, will provide a satisfactory picture of the shoot apex as seen in the cycads.

The shoot apex, in mature plants, is deeply sunken and closely invested by a protective armor of leaf bases and cataphylls. These must be removed with considerable care so as not to injure the delicate tip within. The microtechnique outlined by Ball (1941) for the shoot apex will yield excellent preparations.

The apex is characteristically mound-like or broadly cone-shaped in outline and relatively enormous in size. That of *Cycas revoluta* measures 2018-3305 μ in diameter, of *Microcycas calocoma* 500-2000 μ, of *Dioon edule* 1677-1941 μ, of *Encephalartos* 856-1263 μ, of *Bowenia serrulata* 1246 μ, of *Zamia integrifolia* 400-860 μ, and that of an embryo of *Macrozamia Moorii* 625 μ. These dimensions surpass anything reported for other seed plants. Boke (1941) gives 700-900 μ for *Trichocerus spachianus* which appears to be the largest on record among angiosperms.

Median or near-median longsections show that the shoot apex is divided into three or four zones. This condition is indicated schematically in figure 1 and may be observed in the photomicrographs, figures 2 and 3. The summit is occupied by a region of initiation (zone 1); immediately beneath is a core of central mother cells (zone 2) which is underlaid by a rib meristem (zone 4). The three axial zones are surrounded by a series of flanking or peripheral layers (zone 3). Each zone may be distinguished by its contribution to the growth of the shoot as well as by such characteristics as: cell size and arrangement, degree of vacuolation, staining qualities of the nucleus, and thickness of cell walls.

Zone of initiation (zone 1). This zone consists of the relatively small, thin-walled, densely protoplasmic cells in the upper part of the shoot apex.[1] The actual number of cells involved depends upon the size and shape of the apex. In small conical apices there are about a dozen superficial cells, in larger ones from 50 to 100, while in the large dome-shaped apices of *Cycas revoluta* the number will be much higher. There is nothing to suggest an apical cell or even a clearly defined group of initials, for the superficial cells at the summit are indistinguishable from those of zone 3 except possibly by difference in size. Periclinal divisions are sufficiently frequent in both the superficial layer and its derivatives to build somewhat irregular files of daughters which converge toward zone 2 (Fig. 1B). In *Microcycas calocoma* anticlinal and oblique divi-

[1] In two instances I have found large vacuoles in the superficial cells of *Encephalartos*. The specimens were in a dormant condition.

sions at the top "deflect" the files thereby producing a conspicuous fan-like appearance.

Central mother cells (zone 2). The central portion of the apex is occupied by a core of tissue roughly spherical, obovoid, cylindrical or fan-like in shape, which is concerned with increase in volume and generation of new cells from its base and sides. Zone 2 originates from the lower part of zone 1, Fig. 1B. Divisions are in all planes but since the daughter cells tend to remain enclosed by the original mother wall a complex arrangement of vertical files and blocks of cells result having the general appearance of a "massiges Meristem." In *Cycas revoluta* vertical files may occur at any level in the central tissue thus making it difficult or impossible to distinguish the central mother cells from the rib meristem. The enlarged mother cells contain thin cytoplasm with large vacuoles and faintly staining nuclei. Their walls are considerably thickened, especially where several cells touch, and display prominent primary pit fields. When the majority of the cells enlarge at one time zone 2 becomes the most conspicuous feature in the apex, (Fig. 2). Following enlargement the mother cells may divide sporadically throughout the zone, while at the periphery they give rise to the rib meristem, (Fig. 1A) and most of the peripheral layers. Apices of *Zamia* which are gorged with starch fail to show a vacuolate central mother cell zone (Fig. 3.)

Peripheral tissue zone (zone 3). The zone of initiation and the central mother cells are flanked by this tissue. It is clearly separated into an inner and outer portion. The outer part consists of relatively small, thin-walled, deeply staining, mitotically active cells which owe their origin to divisions in the edge of the initiation zone and to periclinal divisions in the surface layer. The derivatives from the latter may divide in any plane, thereby producing a complex cellular pattern in which cell lineage can not be traced. However, periclinal divisions may predominate and build short files at right angles to the surface (Fig. 1c). Leaf primordia originate from the base of the outer peripheral tissue. The inner layers of the peripheral tissue radiate from and have their origin in the edge of the core of central mother cells. The cells here are larger, more vacuolate and appear to divide less frequently than those in the outer layer.

Growth in the peripheral tissue zone is centrifugal. Epidermis, leaf primordia, cortex, pro-vascular tissue, and generally some of the pith are differentiated from peripheral tissue.

Rib meristem (zone 4). The rejuvenated cells at the base of the central mother cell zone build files of daughters which through progressive enlargement ultimately mature as pith. The thickened walls of zone 2 prove to be temporary and do not persist in the rib meristem. The rib meristem is a conspicuous feature in all the cycads examined except in *Cycas revoluta* where a distinction between central mother cells and rib meristem cannot be observed.

The facts presented in this brief survey of the cycad shoot apex, together with the more complete accounts given by Foster and Johnson, suggest the following considerations which are of general morphological interest and possibly may have phylogenetic significance.

None of the seven genera examined show an apical cell in plants old enough to have a well-developed terminal meristem. One-year old seedlings of *Microcycas calocoma* and two-year seedlings of *Cycas revoluta* have already established the growth pattern which is more fully developed in adults (Foster, 1939b, 1943). In *Zamia* the zonal structure was discovered in an embryo prior

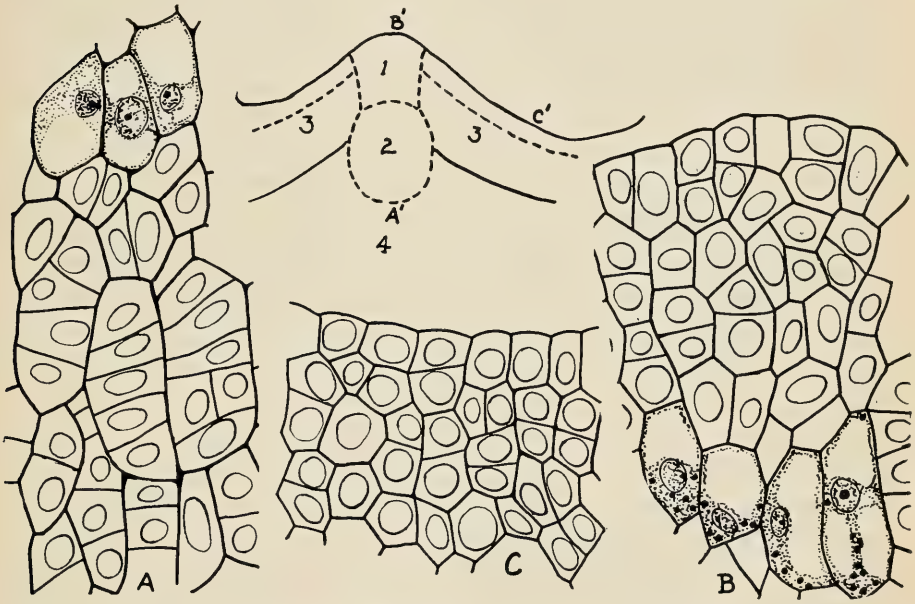

Fig. 1. *Zamia silvicola.* Shoot apex showing zonation: 1, initiation zone, B, detail of same; 2, central mother cell zone, cells containing cytoplasm in B and A are from edge of this zone; 3, peripheral tissue zone, outer portion is derived from zone 1 and the superficial layer as seen in C, inner part is from zones 1 and 2; 4, rib meristem, which originates from zone 2 as seen in A. A, B, and C taken from A', B', C' respectively, × 400.

to emergence from the seed coat. A large cell, in longisection resembling an apical cell, is often seen at the tip of the shoot apex in embryos and seedlings No recent observer, however, has been able to demonstrate that segments are produced from such a cell in the definite sequence required by the apical cell theory. The superficial cells at the exact geometric center of the apex do not differ from their neighbors in either structure or planes of division. Further studies, however, are necessary in the embryology and early growth of the seedling before the possibility of an apical cell can be ruled out.

It is significant that while the apex is divided into zones (Fig. 1), the zones merge more or less and are not sharply delimited as in stratified apices (Figs. 2 and 3). For instance the limits between the initiation zone and the central mother cells fluctuate. The same is true for the central mother cells and the peripheral tissue zone and rib meristem which surround them. The extreme is reached in *Cycas revoluta* where it is impossible to separate the central mother cells, rib meristem and maturing pith. Obviously a histogen theory demanding discrete layers can not be applied to the cycads studied to date. The surface layer continues periclinal divisions throughout the life of the shoot and, therefore, can not be considered as a dermatogen. The concept of a tunica and corpus is likewise untenable. Furthermore the marked zonation definitely precludes considering the apex as a primordial meristem lacking in cellular "differentiation."

Conclusions concerning the similarity of zonation throughout the cycads must remain premature until *Ceratozamia* and *Stangeria* have been investigated. There is, however, a pronounced uniformity in the seven genera studied, if the preliminary account of Johnson (1944) on *Encephalartos, Bowenia* and *Macrozamia* is supported when additional material can be examined. In all, the tissues of the shoot are ultimately derived from the initiation zone. Likewise there is a marked similarity in the central mother cell zones with their large, highly vacuolate, irregularly arranged cells which often have much thickened walls. Upon rejuvenation these cells, with the exceptions noted for *Cycas revoluta,* contribute to the peripheral zone and rib meristem.

The cycad shoot apex furnishes an excellent study in the coordination of growth. Each of the zones increases in size but does not disrupt the general plan or shape of the apex. Growth converges from the initiation zone to the core of central mother cells (a particularly striking feature in *Dioon* and *Microcycas*). The production of new cells accounts for the increase in size in this case. Growth from the central mother cell zone, on the contrary, is divergent with increase in size through cell division and enlargement in the peripheral tissue and young pith cells. A series of actively meristemmatic centers, arranged in the form of a spiral at the base of the apex in *Zamia, Dioon, Cycas* and *Microcycas,* become the leaf primordia. These centers encroach upon the sides of the

Explanation of Figures 2 and 3

Fig. 2. *Zamia latifoliata.* Note: conspicuously vacuolate central mother cells, irregular files of cells in zone of initiation capping the summit, outer part of peripheral zone with files of cells from periclinal divisions and inner part radiating from central mother cells, also rib meristem at the base of central mother cells. × 230.

Fig. 3. *Z. umbrosa.* Shows apex gorged with starch. Note: absence of vacuoles in central mother cells also planes in which division has occurred, and vertical alignment of cells in zone of initiation. × 230.

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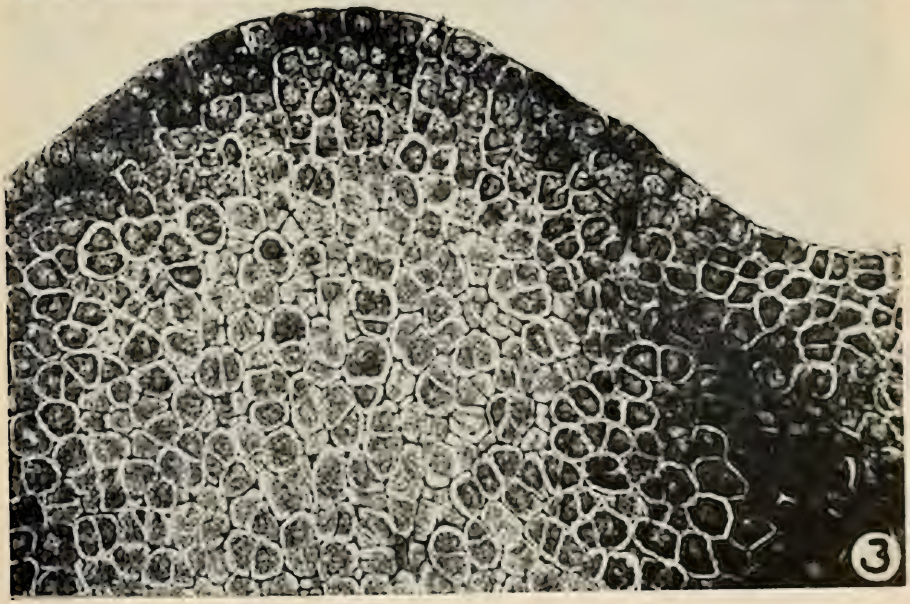
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shoot apex but, again, growth is nicely coordinated and the summit continues to be elevated above the maturing regions.

It is tempting to speculate on the mechanism which permits the maintenance of growth zones. What factors control the enlargement of the central mother cells while they are surrounded by actively dividing neighbors? What agents are responsible for rejuvenation at the periphery of the central mother cell zone? Why should the sides of the apex contain the simplest and least differentiated part of the apex? Undoubtedly the answers to these and other similar questions are to be found in cellular physiology. The location of the various zones with relation to each other and the readiness with which metabolic supplies and products can be obtained and removed are factors of first importance and deserve serious cooperative study by morphologists and physiologists. Future studies on the shoot apex should not only include problems in cell lineage, the cytohistological features of zones and strata, and coordinated patterns of growth, but also an experimental approach which may reveal something concerning the chemical web underlying growth systems.

Zoned apices are by no means confined to the cycads. Foster (1938) has shown that the shoot apex in *Ginkgo biloba* is composed of apical initial, central mother cell, rib meristem and peripheral zones. These zones are comparable in many respects to those in cycads. Among the Coniferales superficial initials at the summit of the apex divide periclinally to produce a relatively small zone of irregularly arranged cells, which in turn give rise to peripheral and central tissue zones (Foster 1939a, 1941a, Cross 1943). Certain angiosperms likewise display a condition approaching that in cycads, (Foster, 1939a). Several investigators have described the corpus as consisting of peripheral and central tissue zones arising from a subterminal apical zone composed of irregularly placed, enlarged and much vacuolate cells, (Boke, 1941, in Cactaceae and Hsü, 1944, in bamboo). The nature of the initiation zone, and extensive development of the central mother cells and peripheral zone in the cycads tend to isolate them from other seed plants. Great caution must be exercised in the construction of phylogenetic schemes illustrating possible evolutionary lines for the shoot apex. The smaller apices of the advanced seed plants with their greater degree of cellular stratification and simpler zonation, may well be admitted as evidence for considering the cycad apex as primitive. Indeed I am strongly inclined to follow the lead of Foster (1940) who has provisionally suggested that the large apex of *Cycas revoluta* with its "wide range of variation in sequence and plane of divisions, especially in the zone of initiation and central tissue zone" would seem to represent a primitive type. A more positive statement cannot be safely made until more extensive comparative studies have been completed throughout vascular plants.

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New Plant Records for the Niagara Frontier

Irving W. Knobloch

This brief list embraces, for the most part, some recently discovered cryptogams for this area although the flowering plants have not been entirely neglected. The catalogue of the non-flowering plants of Buffalo and vicinity prepared by David F. Day in 1882 from the researches of Judge Clinton, Mary L. Wilson, Prof. David S. Kellicott and others is the only record we have of these plants except for the work of the scientists at St. Bonaventure college headed by Drs. Hubert Vecchierello and P. Boehner and several small papers by the writer. A complete revision of the cryptogams in this area is desirable and will be undertaken in the near future.

BLUE-GREEN ALGAE

Plectonema nostocorum Born. was collected for the first time in the Delaware Park greenhouse, Buffalo, N. Y. on January 10, 1944 where it was found on wet rocks. All records of the blue-green algae were checked by Dr. Drouett of the Chicago Museum of Natural History.

Anacystis Peniocystis (Kütz) Dr. and Daily was gathered in the same place and at the same time as the above species and is listed only for the West Indies by Tilden. It is probably more common than collecting records would indicate.

Schizothrix lacustris A Br. was collected on January 1, 1944 in the same situation as the two previous species.

Schizothrix calcicola Gom. was also taken in the park greenhouse but on March 12, 1944.

Entophysalis Cornuana Sauvag. was taken on January 10, 1944 from the same rocks as the above species.

Phormidium tenue (Menegh.) Gom. is common on damp rocks around the fountain in the South Park Conservatory, Buffalo, N. Y. where it was gathered on March 6, 1944.

LICHENS

Day lists *Cladonia fimbriata* (L.) Fr. as a component of our flora and determinations by Dr. C. W. Dodge of local specimens indicate that we have the varieties *subulata* (L.) Vain. and *simplex* (Weiss.) FW. Both varieties were collected at Wanakah, N. Y., on April 10, 1944.

LIVERWORTS

Lophocolea heterophylla (Schrad.) Dum. has been reported from Genesee

county by Day and from Cattaraugus county by P. Boehner. The writer located it on dead wood at Wanakah, N. Y., Erie county, on April 25, 1944.

MOSSES

Fissidens grandifrons Brid. is listed in Day's catalogue from Niagara Falls, Niagara county, and from Caledonia Creek, Livingston county. I collected it from wet rocks in the Delaware Park greenhouse, Buffalo, N. Y., Erie county on January 10, 1944.

Bryum argenteum (L.) Brid. was reported by Knobloch and Bleekman from Salamanca, N. Y. It is locally common and specimens were gathered from along the creek in Forest Lawn cemetery, Buffalo, N. Y. on October 24, 1943.

PTERIDOPHYTES

Isoetes sp. was collected along the shores of Chautauqua Lake, Chautauqua county, near Fluvanna on September 7, 1943 but neither Mr. Weatherby nor myself were able to identify the species because of lack of macrospores. Both Clinton and Day found Braun's quillwort in the Niagara river above the falls in the last quarter of the nineteenth century but no specimens have been collected since that time. It is important therefore, to record at least the rediscovery of the genus in this area and further collections will be made soon to clear up the question of the specific rank of our specimens.

ANGIOSPERMS

Streptopus amplexifolius (L.) DC. is not listed in Zenkert's flora. An atypical specimen was found on W. Kenmore road, Tonawanda, N. Y., on June 25, 1928 by the late Dr. G. C. Hicks which both Dr. Etlar Nielsen and myself think belongs here.

Microstylis unifolia (Michx.) BSP. has been recorded for both Erie and Wyoming counties by others but the writer found it in the Allegany State Park, Cattaraugus county, on August 25, 1928.

Asarum reflexum Bickn. is rarer locally than *A. canadense*. It has been found previously at North Evans, Erie county, and at Quaker Run, Cattaraugus county. I collected it on Buckhorn Island in the Niagara river on May 30, 1943.

Amelanchier humilis Wiegand is listed as rare and from Genesee county by Zenkert in his flora of the Niagara Frontier. Dr. Nielsen identified a local specimen as *A. humilis* Wiegand var. *typica* Nielsen which had been collected by P. Hoffman along Transit road near Buffalo, N. Y., on April 27, 1938.

All of the above specimens are either in the herbarium of the University of Buffalo or in the writer's collection.

Biology Department
University of Buffalo

Observations on the Distribution of some Aquatic Plants in Guatemala

W. C. Muenscher

In the preparation of a flora or catalogue of plants of a region, the aquatic vegetation frequently receives the least consideration. Directly, this incomplete treatment of the distribution and taxonomy of the plants growing in the hydrophytic habitat is explained by the paucity of herbarium specimens available to taxonomists. Indirectly, two other factors undoubtedly contribute considerably to the neglect of this group: first, the assumption that most aquatic plants being rather cosmopolitan in their distribution, collections of these are, therefore, not likely to yield novelties; second, the inaccessibility of the aquatic habitat to the botanical collector not provided with special equipment for collecting in the water frequently results in his not attempting to take any specimens.

During the spring of 1937, while working in Central America, I had an opportunity to observe the distribution of aquatic plants in a number of ponds and streams in Guatemala. In addition to these incidental observations, a day was spent in a boat on each of the three larger lakes, Izabal, at tidewater, Amatitlan, 4000 ft. elevation, and Atitlan, 5000 ft. elevation above sea-level.

Assistance in the determination of plants has been received from the following: Dr. Wm. R. Maxon, Pteridophytes; Mrs. Agnes Chase, grasses; Dr. R. T. Clausen, *Najas;* Dr. H. K. Svensen, *Eleocharis;* Dr. Paul Standley, miscellaneous specimens. To these taxonomists and also to Mr. George W. Perkins, Mr. E. J. LeGarde and Col. Victor E. Ruehl, who facilitated my travels in Guatemala, I express my sincere thanks. The herbarium specimens cited are deposited in the herbarium of Cornell University.

Annotated List of Some Aquatic Plants of Guatemala

(Based upon observations and collections made by W. C. Muenscher, April 8—May 23, 1937)

SALVINIACEAE

Salvinia rotundifolia Willd.

Floating in stagnant backwaters of streams; also in ponds between Puerto Barrios and Quirigua. Rio Dulce, *12180.*

Azolla filiculoides Lam.

In sloughs, sluggish streams, and shallow bays in lakes. Lake Atitlan, *12178, 12179;* Lake Amatitlan, *12177;* near Zacapa.

MARSILIACEAE

Marsilia sp.

Sterile plants in shallow water and on sandy shore of a spring-fed pond at 8000 ft. elevation. Quiché, *12181.*

EQUISETACEAE

Equisetum giganteum L.

In shallow water and marshes along streams, at 7000 ft. elevation on Vulcan Santa Maria, *12183;* Rio Coban, Tactic, *12182.*

TYPHACEAE

Typha truxillensis HBK.

Locally abundant in shallow water and marshes bordering lakes and streams. Lake Amatitlan, *12617;* Lake Izabal; Puerto Barrios; Rio Polochic, near Pancajche.

NAJADACEAE

Najas guadalupensis (Spreng.) Magnus.

In the larger lakes, in water to a depth of ten feet. Lake Amatitlan, *12001, 12002, 12003;* Lake Atitlan, *12004.*

Najas guadalupensis Morong. var. *curassavica* (A. Br.) Magnus and Rendle.

In a spring-fed pond at 8000 ft. elevation. Quiché. *12006.*

POTAMOGETONACEAE

Potamogeton fragillimus Hagstr.

In shallow bays of Lake Atitlan, *12066, 12068, 12069, 12070, 12077.*

Potamogeton foliosus Raf. var. *genuinus* Fernald.

In shallow ponds and lakes. San Felipe, Lake Izabal, *12074;* Finca Moca, *12075.*

Potamogeton gramineus L. var. *graminifolius* Fries.

Frequent in shallow bays of Lake Izabal, about the islands in the Golfete and in the Rio Dulce. Lake Izabal, *12078, 12081; Golfete, 12083, 12084;* Rio Dulce, *12082.*

Potamogeton nodosus Poir.

Local in the Golfete and Rio Dulce. Rio Dulce, *12080, 12085.*

Potamogeton pusillus L.

Shallow lakes and sluggish streams. In spring-fed pond, 8000 ft. elevation, Quiché, *12005;* Lake Atitlan, *12069;* Rio Dulce, *12086, 12079.*

Ruppia maritima L.

Abundant in the Rio Dulce; local in Lake Atitlan. Rio Dulce, *12072a; 12624;* Lake Atitlan, *12067, 12071, 12076.*

ALISMACEAE

Echinodorus macrophyllus (Kunth.) Micheli.

In shallow water, sloughs and marshes along the Rio Motagua and Rio Dulce. Quirigua, *12065.*

Sagittaria lancifolia L.

In shallow water and marshes along the Rio Polochic, Rio Dulce, Rio Motagua and Golfete. Panzos, *12060.*

HYDROCHARITACEAE

Thalassia testudinum Koenig and Sims.

Common in salt water along the coast between Puerto Barrios and Livingston. Puerto Barrios, *12063.*

Vallisneria americana Michx.

In shallow bays of Lake Izabal, Golfete and Rio Dulce. Estor, Lake Izabal, *12621;* Rio Dulce, *12620.*

GRAMINEAE

Panicum paludivagum Hitchc. and Chase.

In shallow water; the spreading rhizomes sometimes form dense mats in stagnant bays and sluggish streams. Lake Amatitlan, *12214;* Panzos, Rio Polochic; Rio Dulce.

Paspalum virgatum L.

In brackish marshes, Puerto Barrios, *12232.*

Phragmites communis L.

In shallow water and marshes along the shore of Lake Amatitlan and Golfete.

CYPERACEAE

Cyperus canus Presl.

In swamps along shore of Lake Amatitlan, *12052.*

Cyperus giganteus Vahl.

In sloughs and swamps between Puerto Barrios and Bananero.

Cyperus Humboldtianus Steud.

Wet shores of streams and ponds. Finca Moca, *12039;* Rio Lima, *12032a.*

Cyperus Luzulae (L.) Retz.

In swamps and borders of streams. Panzos, *12570.*

Eleocharis retroflexa (Poir.) Urban.

In shallow water and wet borders of streams and lakes. Lake Atitlan, *12028;* springy bank by waterfall, 7000 ft. elevation, Vulcan Santa Maria, *12044.*

Eleocharis caribaea (Rottb.) Blake.

In warm water by edge of hot spring on shore of Lake Amatitlan, *12050.*

Eleocharis filiculmis Kunth.

In shallow water and marshes bordering streams and lakes. Rio Coban, Tactic, *12025;* Finca Moca, *12037.*

Eleocharis geniculata (L.) R. & S.

Along borders of lakes, ponds and streams. Lake Atitlan, *12056;* Finca Moca, *12036;* Rio Coban, Tactic, *12026.*

Eleocharis interstincta (Vahl.) R. & S.

In shallow water, Lake Amatitlan, *12055.*

Fimbristylis miliacea (L.) Vahl.

In lowland marshes and on wet shores. Rio Lima, *12032;* Puerto Barrios, *12015.*

Mariscus jamaicensis (Crantz) Britton.

In shallow water along the Golfete and Rio Dulce. Rio Dulce, *12019.*

Scirpus californicus (Mey.) Britton.

Local in shallow bays of lakes and Rio Dulce; abundant about the islands in the Golfete. Lake Amatitlan, *12053, 12054;* Rio Dulce, *12018.*

Scirpus cubensis Pers.

In shallow water along shore of Rio Dulce and Golfete. Rio Dulce, *12020.*

Scleria microcarpa Nees.

In marshes along Rio Polochic, Rio Dulce and the Golfete. Panzos, *12023.*

Scleria latifolia Sw.

Along shore of Golfete and in swamps between Puerto Barrios and Tenedores. Golfete, *12023a.*

ARACEAE

Pistia stratiotes L.

The floating rosettes of spongy leaves form dense mats over the surface of quiet water in ponds and streams. San Felipe, Lake Izabal, *12618;* Rio Dulce; Rio Lampara; "Section 4" between Puerto Barrios and Tenedores.

PONTEDERIACEAE

Heteranthera reniformis Ruiz, & Pav.

In shallow water and along muddy flats of lakes, ponds and streams. Lake Amatitlan, *12615;* Coban, *12613;* Puerto Barrios, *12614.*

Pontederia cordata L. (*P. rotundifolia*)

In shallow water and marshy shores of lakes and sluggish streams. Rio Polochic, Panzos, *12622;* Rio Dulce, *12623;* Lake Izabal; Golfete; ponds near Tenedores.

JUNCACEAE

Juncus effusus L.

In shallow pond and bordering marsh, Coban, *12043.*

Juncus marginatus Rostk.

In swamps, Rio Coban, Tactic, *12024.*

AMARYLLIDACEAE

Hymenocallis littoralis (Jacq.) Salisb.

In shallow water along the borders of mangrove swamps along the east end of the Golfete and shores of the Rio Dulce, *12061.*

CERATOPHYLLACEAE

Ceratophyllum demersum L.

Widely distributed in shallow water. Lake Atitlan, *12608;* San Felipe, Lake Izabal, *12609;* Rio Dulce, *12610.*

NYMPHAEACEAE

Cabomba aquatica Aubl.

In shallow bays of lakes and streams. Lake Izabal, *12611;* Rio Dulce, *12612;* Golfete.

Nymphaea ampla (Salisb.) DC.

Infrequent in shallow bays and sluggish streams. Rio Dulce, near mouth of Rio Lampara, *12619;* pond near northwest corner of Lake Amatitlan.

CRUCIFERAE

Nasturtium officinale R. Br.

In small streams in the mountains at 10,000 ft. elevation. Mount Maria Tecum, *12047.*

RHIZOPHORACEAE

Rhizophora Mangle L.

Medium-sized trees with prop-roots in soft mud on tidal flats, Rio Dulce and Golfete. Rio Dulce, *12017.*

ONAGRACEAE

Jussiaea peruviana L.

In shallow water and on marshy banks of streams. Rio Siguacan, *12029.*

Jussiaea repens L.

In shallow water in lakes and sluggish streams. Lake Atitlan, *12059.*

Jussiaea suffruticosa L.

In shallow water and marshes bordering on lakes and streams. Lake Atitlan, *12058;* Pancajche, *12558.*

UMBELLIFERAE

Hydrocotyle mexicana Cham. and Schlecht.

Wet banks of streams. Coban, *12027;* Finca Helvetia, Esquintla, *12045.*

Hydrocotyle umbellata L.

In shallow water and on sandy shores of lakes and ponds. Finca Moca, *12038;* Lake Atitlan, *12057.*

PODOSTEMACEAE

Maranthrum foeniculaceum H. & B.

On boulders in swift streams on the Pacific slope. Rio Lima, *12034, 12035.*

Maranthrum Schiedeanum Cham.

On boulders in swift streams on the Pacific slope. Rio Siguacan, *12031.*

Tristicha hypnoides (St. Hil.) Spreng.

On boulders in swift streams, usually associated with the two preceding species. Rio Lima, *12033;* Rio Siguacan, *12030.*

LENTIBULARIACEAE

Utricularia obtusa Sw.

In sluggish backwaters, Rio Dulce, *12616.*

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Damage to Trees in New York City in the Hurricane of September 14, 1944

ARTHUR HARMOUNT GRAVES

Trees, often of large size, uprooted in the parks, botanic gardens, private estates, and woodland areas, or blown over to an angle quite at variance with their natural geotropic or plagiotropic tendencies, are now a familiar sight to anyone who has lately visited one or more of the five boroughs which comprise Greater New York. And, as everyone knows, these are some of the results of the great hurricane[1] which struck New York City with devastating force on September 14, 1944.

The damage was far more severe than that resulting from the hurricane of September 21, 1938, the main reasons being that in the recent storm the City was more directly in its path; the wind was more violent—81 miles per hour (maximum 99 m.p.h.) as compared with 70 miles per hour in 1938 (maximum 80 m.p.h.); the duration of the storm was longer—about 5 hours as against 4 hours.[2]

It will be recalled that in the 1938 storm one of the most important factors in the overthrow of trees and shrubs was the watersoaked condition of the soil. Because of this, the hold of the roots was weakened. In 1938 the rainfall from September 13 to September 21 (including the hurricane rain) amounted to 8.54 inches—quite a sizable soaking for an eight-day period in these parts.

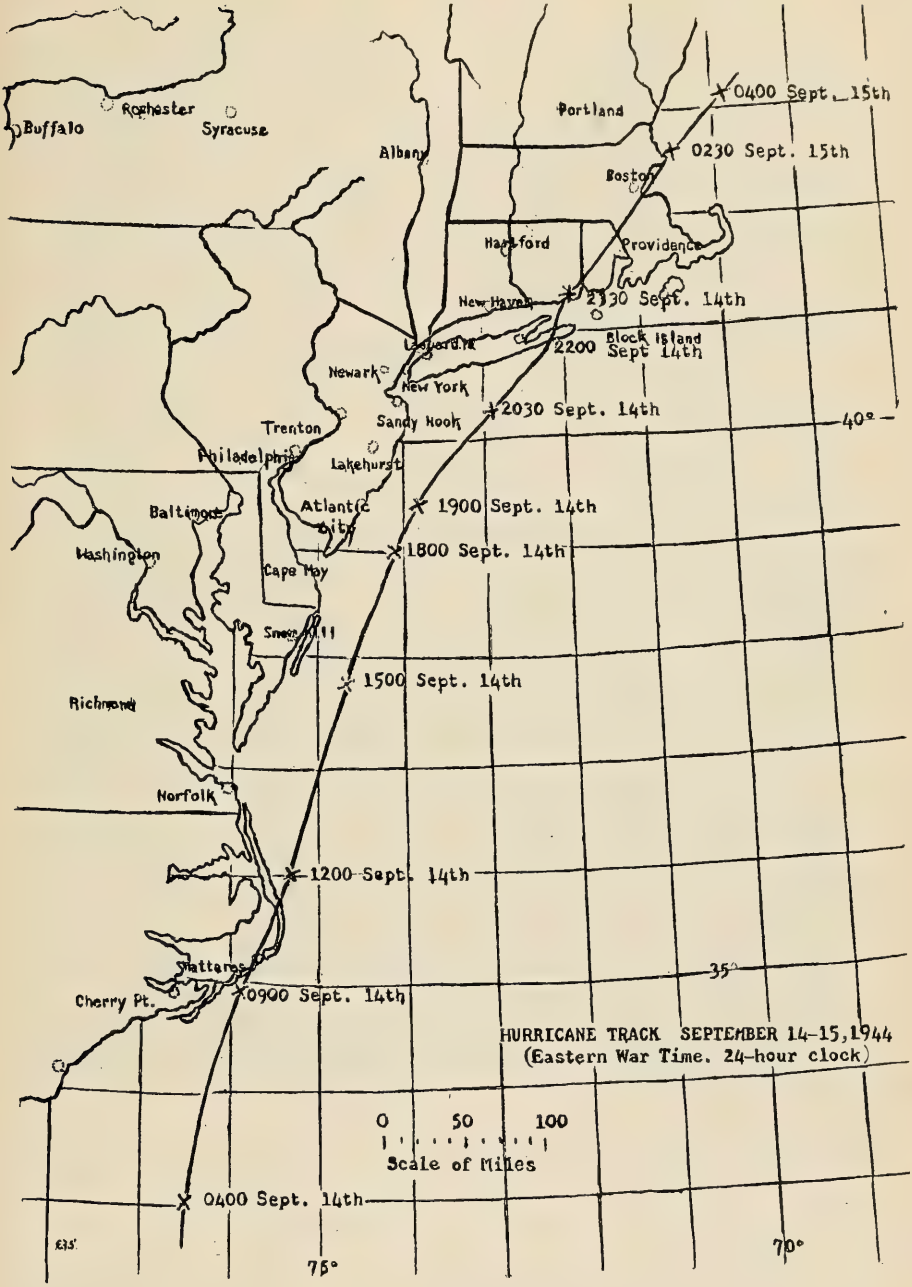
That there was a similar preliminary soaking of the soil in the 1944 storm is borne out by the figures—8.32 inches rainfall from September 1 to and including September 14. However, the soaking in the former period was more gradual, extending over a period of 8 days, while the larger part of the water in the recent storm fell on the 12th, 13th, and 14th—1.86, 3.43 and 2.93 inches

[1] The word "hurricane" originally came from the natives of the West Indies or Central America. It is an Indian word. By early navigators at and following the time of Columbus, the word was variously given as "aracan," "huiranvacan," "urican," "hurican," etc. It is claimed by some to be a Carib Indian word signifying "big wind." According to Professor Lehmann-Nitsche, the god of stormy weather was "Hunrakan" to the Indians of Guatemala, from whom the word hurricane came. From "Hurricanes, their nature and history," by Ivan Ray Tannehill. 5th ed. Princeton Univ. Press. Princeton, N. J. 1944. p. 44.

[2] These figures as well as the following have been kindly furnished me by Mr. Benjamin Parry, Chief of the U. S. Weather Bureau at Whitehall Building, Manhattan, New York City.

Explanation of figure 1

Reproduced, with permission, from "Report of Hurricane, September 14, 1944 (provisional)." Prepared under the direction of Benjamin Parry, Meteorologist in Charge, U. S. Weather Bureau Office, New York, N. Y., October 9, 1944.


Buffalo
Rochester
Syracuse
Albany
Portland
0400 Sept. 15th
0230 Sept. 15th
Boston
Hartford
Providence
New Haven
2330 Sept. 14th
Block Island
2200 Sept 14th
Newark
New York
Sandy Hook
2030 Sept. 14th
40°
Trenton
Philadelphia
Lakehurst
Atlantic City
1900 Sept. 14th
Baltimore
Washington
1800 Sept. 14th
Cape May
Richmond
1500 Sept. 14th
Norfolk
1200 Sept. 14th
Hatteras
35°
Cherry Pt.
0900 Sept. 14th
HURRICANE TRACK SEPTEMBER 14-15,1944
(Eastern War Time. 24-hour clock)
0 50 100
Scale of Miles
0400 Sept. 14th
75°
70°

respectively. Thus the earth was not in quite such a uniformly soaked condition as in 1938.

But the fact that in the 1944 storm the soil was not quite so favorable to uprooting was obviously much more than counter-balanced by the powerful factors above stated—stronger winds, lasting longer, and the position of the New York City area more nearly in the path of the hurricane.

According to present reports, the 1944 hurricane started somewhere in the West Indies, proceeded in a northwesterly direction to the Cape Hatteras region, then curved in a northeasterly direction along the coast, crossing Long Island near Bridgehampton, and entering Connecticut somewhere between New Haven and New London, thence northeastward to the region of Boston, Mass. and finally out to sea (Fig. 1).

At the Brooklyn Botanic Garden, counting all trees and shrubs overthrown or blown over to a leaning position, the number was between 400 and 500, according to Mr. Montague Free, Horticulturist of the Garden. Seventy-five large trees a foot or more in diameter are down, also 150 small trees averaging 6 inches in diameter, and about 200 that need straightening. The Garden has lost many valuable specimens that can not be replaced. This is obvious in the case of the older, larger trees that have been growing 25 years or more. Two fine large specimens of the Golden Larch (*Pseudolarix amabilis*) at the northern end of the Oriental Garden have been lost, also a very valuable tree of Toona (*Cedrela sinensis*) (Fig. 2) a relative of the Cigarbox Cedar, about 40 feet high and 1½ feet in diameter, is gone. The Garden had two of these trees back in 1942, but in the winter of 1942-3 a severe cold spell killed one. A large Oleaster (*Elaeagnus angustifolia*) 1½ feet in diameter, north of the Children's House is gone. In the Wild Flower Garden a fine tulip tree planted in October, 1913, by Adolph Engler, is a total loss, as well as another smaller tulip close to it.

West of the Rose Garden a large *Platanus orientalis* believed to be the only large specimen in this vicinity, is down. In the Elm Family section a large Siberian Elm (*Ulmus pumila*) was broken off squarely, 12 feet from the ground. Three large Black Locusts (*Robinia Pseudoacacia*) (Fig. 3), two of them rare varieties, west of the Lily Pools, and large trees of the Cottonwood (*Populus Eugenei*) and Chinese Poplar (*Populus szechuanica*) near the southern boulder bridge were blown over. One of the large Atlas Cedars (*Cedrus atlantica*) near the west slope of Boulder Hill was blown over but has now been straightened.

Besides such rare individuals, 6 large willow trees, near the brook, two large London Planes on the top of Boulder Hill and a considerable number of poplars in the row east of the experimental plot and the Children's Garden, on the museum embankment and on the west border of the horticultural section are either down or leaning over.

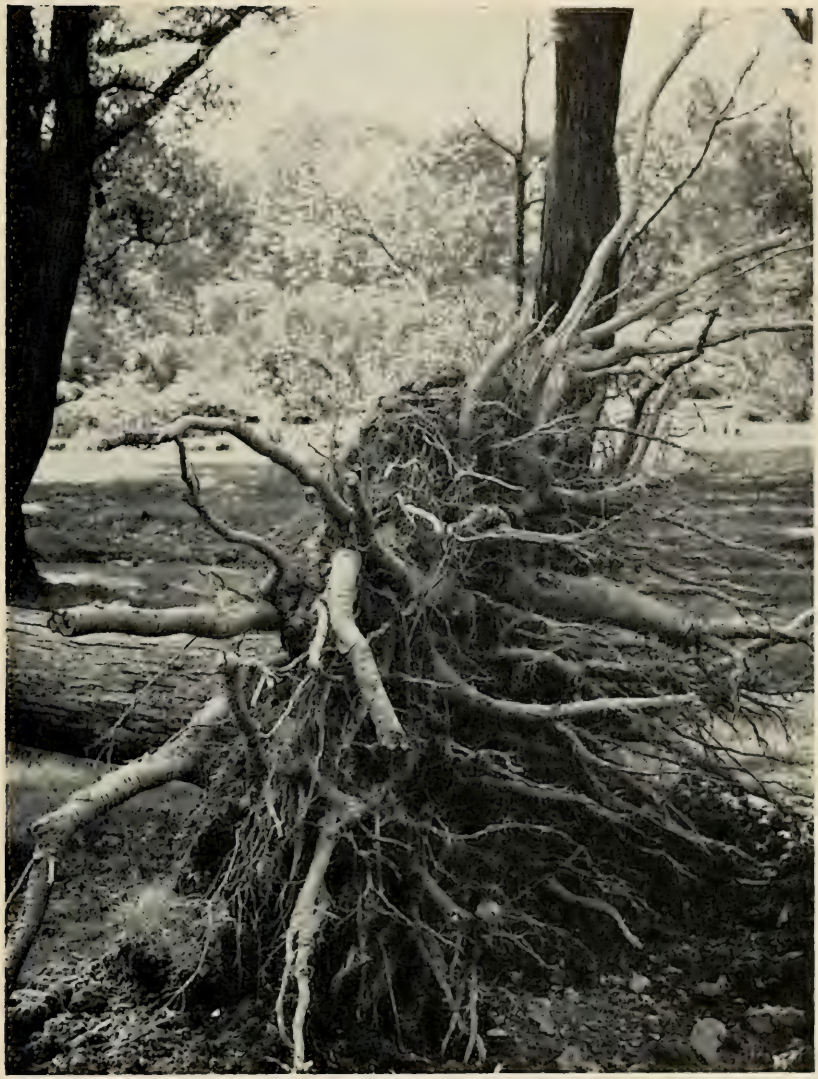


FIG. 2. Toona (*Cedrela sinensis*) Brooklyn Botanic Garden, showing a mass of thick, strong, vertical roots. Photo by Mr. Louis Buhle, Brooklyn Botanic Garden, September 16, 1944.

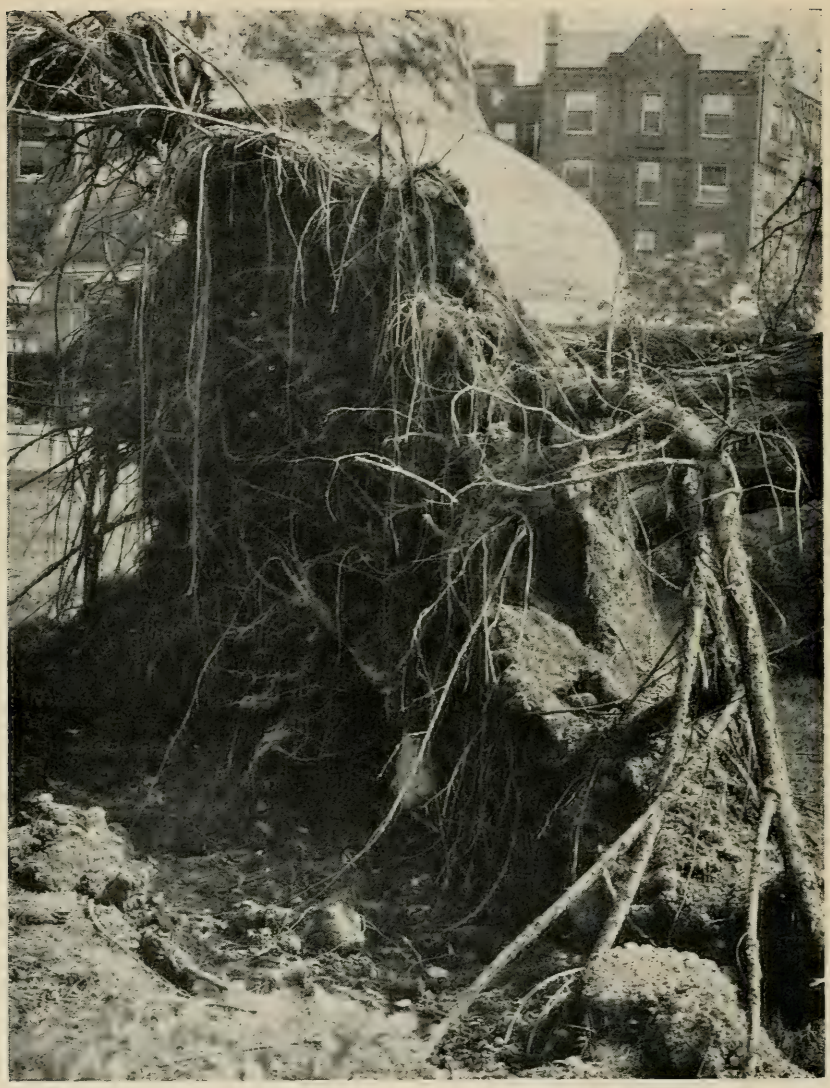


FIG. 3. Black Locust (*Robinia Pseudoacacia*) near Lily Pools and Conservatories, Brooklyn Botanic Garden, showing more or less shallow root system. Photo by Mr. Louis Buhle, Brooklyn Botanic Garden, September 16, 1944.

Outside of the Brooklyn Botanic Garden, Mr. David D. Schweizer, Director of Horticulture of the New York City Park Department, reports that in the whole City, 16,000 street trees are to be removed and 12,000 are to be straightened; while 7,600 park trees are to be removed, and 5,220 are to be straightened. Mr. Carl J. Schiff, Arboriculturist of Brooklyn, reports that 979 trees are down in Prospect Park, and 150 require straightening, and Mr. T. H. Everett, Horticulturist of The New York Botanical Garden, states that 180 large trees are down in that Garden, some of them huge specimens.

Of the Boroughs the worst sufferer was Queens, and next in order came Brooklyn, Bronx, Manhattan and Richmond. Fort Tryon Park did not suffer heavily, but about a half dozen big trees in the region of the Cloisters were lost. Inwood was damaged only slightly, perhaps because of a somewhat protected position. These last two areas, as well as Westchester, were also more remote from the path of the hurricane.

At first we believed that the great losses in the Brooklyn Botanic Garden could be explained from the early history of the Garden. For the land now occupied by the Garden was formerly used by the City for dumping rubbish; hence the subsoil might be expected to contain a stony or coal ash mixture not conducive to the development of deep root systems. We know that in grading for the Rose Garden in 1927 the remains of an old city roadbed were unearthed.[3] However, Prospect Park, which adjoins the Garden, across Flatbush Avenue to the westward, has no such history. As old pictures show,[4] it was formerly open land and woods with farms and an occasional large estate. Yet I found the damage just as severe in Prospect Park as in the Botanic Garden.

Was there any reason why certain trees were uprooted and others remained standing? Possibly a naturally shallow root system was the answer. This is well known to be the case with willows and poplars. But by no means did all uprooted trees have shallow root systems.

After considerable study, following several leads, and visiting various parts of the City, I came to the conclusion that the true solution of the whole problem lies in the fact that there existed *tornadic wind currents* within the hurricane area. If a tree happened to stand in the path of one of these currents the character of its root system mattered little. An example of one such tornadic current can be seen in Prospect Park. In the Park it started at the northwest corner near the Plaza entrance, snapping off a trunk of the rare Yellow-wood (*Cladrastis lutea*) about 12 feet from the ground, and after other minor damage it crossed the road and meadow in a southeasterly direction leaving many fine trees intact on the way, but uprooting a large European Linden and two

[3] However, in talking with old residents, I find that in the old days the Garden land was not as unattractive as it is sometimes pictured.

[4] Sixth Ann. Rept. of Commissioners of Prospect Park, 1866. Map opposite p. 104. Also Seventh Ann. Rept. 1867. Frontispiece, "The Battle Pass in 1866."

small Norway Maples near the east road. Going on southward, it almost avoided the Vale of Kashmir (which is in reality an old "kettlehole" and therefore sunken and protected) but mowed down some Wild Cherry and Sassafras on the western edge; thence to the region south of the rose garden it took an English Elm (*Ulmus procera*), and farther down on the east path it uprooted a giant London Plane, 3½ feet D.B.H. and 90 feet high, a landmark for nearly a century. Coffee Trees (not particularly shallow rooted) a little to the west, and finally, among others, a handsome Silver Linden (*Tilia tomentosa*) just west of the Zoological Garden. But this was by no means the only current. There were many others throughout the park so that the results seemed to have no "rhyme or reason." Truly, as we have often been told, "The wind bloweth where it listeth . . . , but [thou] canst not tell whence it cometh, and whither it goeth." John 3 : 8.

A friend told me that during the 1938 hurricane, in Hartford, Conn., where it was particularly severe, she happened to be looking out of the window while the storm was at its worst. The wind was bending a large Silver Maple almost to the ground. Suddenly a change came and a large branch was snapped off in the *opposite direction*. This illustrates the tornadic or twisting effect[5] of winds within the hurricane.

However, there is no question but that large trees with *shallow root systems,* especially if located in moist soil, might be blown over while nearby trees with deeper roots might be untouched. In such a case the cause would not necessarily be a tornadic wind current, but the continued *force* lasting for hours, of a violent wind. Such a tree I saw in the Kissena Park region, a large Pin Oak (*Quercus palustris*) lying prostrate, its upturned roots revealing its characteristically shallow root system. It had grown near the road skirting the swamp southeast of Kissena Park. Its fellows, *Nyssa sylvatica, Prunus serotina,* and other Pin Oaks, all of *lesser height,* were untouched.

Sometimes it seemed as if certain streets, or perhaps open places between high apartment buildings, especially if they had a north-south, or northwest-southeast direction, formed channels for the wind (which in the N. Y. area came from the north or northwest). Then a tree standing in or at the southern end of such a channel or "canyon" was marked for destruction. Mr. Everett also observed that the *location* of a tree seemed to be more important than the *kind* of tree in determining its survival. For example, not one of the tulip trees on the south side of the Museum Building of The New York Botanical Garden was lost, but north of the building a dozen were down.

Many large London Planes (*Platanus acerifolia*) were uprooted, especially in the parks. I believe that here the enormous butt was a decisive factor. For

[5] Tornado is from Latin *tornare,* to turn. We often on a windy day see miniature tornadoes—small dust whirls traveling along the streets. These illustrate what apparently happens within a large hurricane.

when blown over to an angle, let us say, of 45°, the sheer weight of this butt as well as of the upper parts pulled up the roots or broke them off like a powerful lever and thus completed the destruction which the wind started.

Another point, brought out by several of the City park authorities, is that of resisting leaf surface. Trees with a thick crop of leaves, as in the Norway Maple (*Acer platanoides*), were more subject to windthrow.

Also trees affected with heart rot were ill prepared for the test. Many were snapped off at some distance from the ground—a practical illustration of the function of heartwood—to support the tree.

From the above account it will be clear, I think, that the causes of windthrow in hurricanes are often complex. Each tree presents a problem by itself. In the following table I have summarized the main causes.

Causes of Hurricane Windthrow

I. Shallow Root System
   A. Natural: Poplars, Willows.
   B. Acquired:
      1. Due to shallow soil, underlaid with clay, hardpan, or bedrock.
      2. Due to shallow original planting.

II. Soil Watersoaked and hence offering little resistance to uprooting.

III. Trunks with Heavy Butts, making recovery impossible when blown beyond critical angle. e.g. London Planes.

IV. Large Leaf Surface, offering resistance, e.g. Norway Maples, some Oaks, Ailanthus.

V. Trunks Weakened by heart rot.

VI. Roots Weakened, partially rotted, or cut off in grading operations.

VII. Position of Tree, facing an open exposure as in streets in or at end of "canyon" between houses.

VIII. Position of Tree in Path of Tornadic Current.

I can not end this account without a few words from an entirely different angle. One can not pass a tree day after day for several years and become acquainted with its various moods throughout the seasons without acquiring a sense of companionship—for here is a living being—of another kind of life, it is true—and yet an individual which one knows and loves. And when it is suddenly uprooted, as many fine specimens were last September, one feels a sense of loss, akin to the loss of an old friend. A year or two hence, a stranger visiting our city may think the damage from the hurricane could not have been as bad as described, because the streets and parks will appear quite normal. But certain individual trees, well-known to the passer-by, will be missed for years to come.

Brooklyn Botanic Garden
Brooklyn, New York

Notes on Spergularia

Myron Arthur Rice

In his study of *Spergularia* the writer has given some attention to the genus as it occurs in the northern part of the Cayuga Lake Basin, N. Y., and to the collections by K. M. Wiegand, W. C. Muenscher, and R. T. Clausen deposited in the Cornell University Herbarium. *Muenscher 16953,* from an island by Cayuga Bridge, N. Y., April 15, 1927, and *Clausen 4026,* from Savannah Township, Wayne County, N. Y., August 31, 1939, are especially interesting. Cayuga Bridge at Cayuga is near the northern end of Cayuga Lake and Savannah Township is some miles farther north, embracing part of the Montezuma Marsh area.

Muenscher 16953 from Cayuga Bridge agrees quite well with Rossbach's (1940) description of *Spergularia media* (L.) Presl. and it is so labeled in the herbarium. Plants grown in the greenhouse from seeds of this collection had 9-10 stamens, a character of *S. media.* Although Rossbach gives the seeds of *S. media* as usually winged, all of the seeds of *Muenscher 16953,* as represented by the greenhouse-grown plants, are winged, so far as a careful check of the seeds in two capsules showed. All shattered out seeds in a packet on the herbarium sheet are also winged. Rossbach describes the petals of *S. media* as white. The plants grown in the greenhouse had petals which were pink, but whitish toward the base. Mounted herbarium specimens of these greenhouse plants still show the pink color. The same color appears in some flower material in the packet attached to the herbarium sheet, *Muenscher 16953.*

Clausen 4026 from Savannah Township is a different kind of *Spergularia.* Plants grown in the greenhouse from seeds of this collection had 3-6 stamens, averaging about 4. In a complete check of the seeds in 12 capsules, 35 percent of the total number of seeds was winged and 65 percent was not winged. Wiegand's (1920) original description of *S. alata* specifies stamens 4-6 and all seeds winged. All of the 79 seeds in one capsule of a co-type specimen, *F. P. Metcalf & K. M. Wiegand 6406,* Montezuma, N. Y., July 4, 1916, Cornell University Herbarium, were found to be winged. An examination of the seeds in the packet on the herbarium sheet, *A. J. Eames, L. F. Randolph, & K. M. Wiegand 12004* from Montezuma, N. Y., September 9, 1919, labeled *S. alata* Wiegand, reveals, however, that some of the seeds are not winged. It seems evident that the *Spergularia* denominated *S. alata* by Wiegand may have both seeds winged and seeds not winged even though the original type and co-type specimens produced winged seeds only. *Clausen 4026* is interpreted as *S. alata* Wiegand and it is so labeled in the herbarium, but it is a somewhat pubescent form of the species.

The following table shows some comparisons of the Muenscher and Clausen collections. The data were obtained from plants grown in the greenhouse from seeds of these collections.

	Muenscher 16953 *S. media*	*Clausen 4026* *S. alata*
Ave. no. seeds per capsule	137	60
Variation in no. seeds per capsule	119–155	48–76
Percent seeds winged, all capsules	100	35
Percent seeds not winged, all capsules	0	65
Ave. number stamens per flower	9–10	4
Variation in no. stamens per flower	9–10	3–6

Rossbach (1940) holds to the view that *S. alata,* as described by Wiegand (1920), should be included in *S. media* and does not consider that the former species has sufficient taxonomic distinctiveness to warrant a separate identity. *Muenscher 16953* from Cayuga Bridge, now regarded as *S. media,* and *Clausen 4026* from Savannah Township, judged to be *S. alata,* supply evidence in support of the maintenance of the separation.

The writer is much indebted to Dr. W. C. Muenscher, who first suggested the study of *Spergularia* to him, and who has provided materials, facilities, advice, and guidance.

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Ithaca, New York

Literature Cited

Rossbach, Ruth P. 1940. *Spergularia* in North and South America. Dhodora **42**: 57-83; 105-143; 158-193; 203-213.

Wiegand, K. M. 1920. A new species of *Spergularia.* Rhodora **22**: 15.

PROCEEDINGS OF THE CLUB

MINUTES OF THE MEETING OF MAY 17, 1944

The meeting was called to order by President Levine at 3:30 p.m. in the Members Room of The New York Botanical Garden Museum. Twenty-two members and guests were present.

The minutes of the preceding meeting were approved as read. Four persons were unanimously elected to annual membership and three to associate membership.

The first speaker on the scientific program was Dr. A. B. Stout who spoke on the "Loss of Incompatibilities in Tetraploid Petunias." Dr. Stout displayed several of the Petunia plants studied. His paper is published in this number of TORREYA, pp. 45-51.

Professor M. A. Johnson of Rutgers University was the second speaker. His talk "On the Structure of the Shoot Apex in Cycads" was illustrated with lantern slides. It also is published in this number of TORREYA, pp. 52-58.

Following the discussion of Professor Johnson's paper, the meeting was adjourned at 4:40 p.m. Tea was then served.

Respectfully submitted,

HONOR M. HOLLINGHURST
RECORDING SECRETARY

MINUTES OF THE MEETING OF OCTOBER 3, 1944

The meeting was called to order by the Vice-President, Dr. Seaver, at 8:15 p.m. at the Brooklyn Botanic Garden. Twenty-nine members and friends were present. The minutes of the preceding meeting were accepted as read. Twenty annual members and six associate members were unanimously elected.

Dr. Karling introduced the question of the motion which had been recommended by the Council to the Club for consideration. The motion was ". . . that the Council recommend to the Club that TORREYA be merged with the BULLETIN beginning with the next volume, that it keep its own name and contents separate within the BULLETIN, enlarging the editorial staff of the BULLETIN to include members now present on TORREYA, and that subscribers to BULLETIN be charged seven dollars in the event that this merger takes place." In the discussion from the floor, questions were raised as to the availability of reprints for persons keeping bound sets, the economy of merging the two publications, the availability of material to warrant keeping TORREYA a separate publication, the maintenance of the policy of publishing material which has a more popular appeal than that published in the BULLETIN, and finally as to the reason for the increase of one dollar in the rate to subscribers. It was moved by Dr. Zimmerman that the Club adopt the recommendation of the Council, that TORREYA and

BULLETIN be merged. Dr. Karling seconded the motion. The motion was defeated by a vote of 8 to 7.

Dr. Graves announced the death of Dr. H. M. Denslow. Dr. Denslow was the last of the charter members of the Club. He died during the summer at the age of 94.

The scientific program of the evening consisted of reports on summer activities by Club members. Dr. Small reported that the trips in the summer field schedule were well attended and quite successful. He paid tribute to the various leaders of the trips. Mr. Ericson told of finding two plants of western origin in Tottenville, Staten Island. Dr. Svenson spoke about the bogs he had visited in northern Pennsylvania. Dr. M. A. Johnson reported finding *Aristolochia* in New Jersey. A fungus parasite on *Pachysandra* was reported by Dr. Seaver.

The meeting was adjourned at 9:25 p.m. so that the members of the Club might enjoy refreshments with their informal discussions.

Respectfully submitted,

HONOR M. HOLLINGHURST
RECORDING SECRETARY

NEWS NOTES

A conference on "New Developments in Wood Products" was held at the New York State College of Forestry at Syracuse University on October 6 and 7. More than 500 delegates attended from 23 States in the Union, and from 4 Provinces of Canada, from England, New Zealand and Australia. New developments in wood utilization for laminated timber structures, for resin-impregnated timber, for cellulose and lignin plastics, for pulp and paper products, etc., were discussed by experts in the various fields. The need of more research in the post-war period was pointed out, and a closer touch of the universities with industry was urged. Plans were announced for three new buildings for the New York State College of Forestry.

This is the third and last number of Torreya for 1944. There should have been a fourth number, but early in the fall, at the time this number was due, there was not enough material on hand. Some material has now accumulated, but the editor will welcome much more. We hope to publish four numbers in 1945.

It is with deep regret that we announce the deaths of the following botanists during the year 1944:

Professor A. H. Reginald Buller, mycologist, of the University of Manitoba, died June 30th.

Dr. H. M. Denslow, charter member and past president of the Torrey Botanical Club, died September 7th.

Mr. A. A. Heller, teacher in Chico High School, Chico, California, and a well-known botanical collector.

Professor William T. Horne, plant pathologist, of the University of California, died April 12th.

Frère Marie-Victorin, Director of the Botanical Institute of the University of Montreal, died July 15th.

INDEX TO VOLUME 44

Acer platanoides, 73
Ailanthus, 73
Allium, 49; *cepa,* 41
Amelanchier humilis var. *typica,* 60
Anacystis Peniocystis, 59
Aquatic plants, Observations on the distribution of some, in Guatemala, 61
Aristolochia, 77
Asarum reflexum, 60
Asclepias syriaca, 27
Aspergillus niger, 12
Azolla filiculoides, 61

Berger, C. A.; Experimental Studies on the Cytology of *Allium cepa,* lecture, 41
Blake, S. F.; Review of "The vegetation and floristics of Bull Run Mountain, Virginia," 36
Bloch, Robert, New experiments on cellular differentiation and histological pattern, lecture, 14
Bowenia, 52, 56; *serrulata,* 53
Bryum argenteum, 60
Buller, A. H. Reginald, 78

Cabomba aquatica, 64
Calopogonium, 2
Cambellosphaera obversa, 43
Capsella, 42
Castilla elastica, 20, 21
Catenochytridium carolinianum, 32; **laterale,** 32
Catenomyces persicinus, 30
Cedrela sinensis, 68, 69
Cedrus atlantica, 68
Centrosema, 2
Ceratophyllum demersum, 64
Ceratozamia, 56
Chrysler, M. A., The evolution in the fern genus, *Gleichenia,* lecture, 40
Chytrids, Three new saprophytic, 30
Cinchona, 1-3; Growing under American control, 1
Cladonia fimbriata var. *simplex,* 59; var. *subulata,* 59
Cladrastis lutea, 71
Coleus hybridus, 14
Crotalaria, 1
Cryptostegia, Improved rooting of cuttings callused on the plant, 8; *grandiflora,* 8, 23; *madagascariensis,* 8, 23
Cuscuta japonica, an Asiatic species new to America, 34, 35; *approximata* var. *urceolata,* 34; *campestris,* 34; *Epilinum,* 34; *Epithymum,* 34; *exaltata,* 35; *suaveolens,* 34
Cycads, On the shoot apex of, 52, 76
Cycas revoluta, 52-57
Cyperus canus, 63; *giganteus,* 63; *Humboldtianus,* 63; *Luzulae,* 63

Damage to trees in New York City in the hurricane of September 14, 1944, 66
Denslow, Herbert M., 14, 77, 78
Dicranopteris pectinata, 40
Dioon, 52, 56; *edule,* 53
Dothidella ulei, 20

Echinodorus macrophyllus, 62
Elaeagnus angustifolia, 68
Eleocharis, 61; *caribaea,* 63; *filiculmis,* 63; *geniculata,* 63; *interstincta,* 63; *retroflexa,* 63
Elsinoe solidaginsis, 24
Encephalartos, 52, 53, 56
Entophysalis Cornuana, 59
Equisetum giganteum, 62
Eugleichenia, 40

Field trips, April, May, 1944, Leaders:
Abbott, Mrs. Laura Woodward, 39
Nearing, G. G., 38
Robbins, William J., 37
Small, John A., 38
Svenson, H. K., 38
Wiley, Farida A., 38
Field trips, Locations:
Brooklyn Botanic Garden, 38, 39
Camp Thendara, 39
Franklin Township, N. J., 38
The New York Botanical Garden, 37
Pine Barrens Island, N. J., 38
Smithfields, N. Y., 38
Watchung Reservation, N. J., 38
Fimbristylis miliacea, 63

Fischer, Col. Arthur F., G.S.C., Growing *Cinchona* under American control, 1, 14.
Fissidens grandifrons, 60
Free, Montague, Plant propagation, lecture, 39

Gager, C. Stuart, Memorial Fund, 43
Ginkgo biloba, 57
Gleichenia, 40
Graves, Arthur Harmount, Damage to trees in New York in the hurricane of September 14, 1944, 66
Guatemala, Observations on the distribution of some aquatic plants in, 61
Guayule, 21-23

Hanson, Anne M., Three new saprophytic chytrids, 44
Heller, A. A., 78
Heteranthera reniformis, 64
Heuer, J. H. & Loomis, H. F., Improved rooting of Cryptostegia cuttings callused on the plant, 8
Hevea brasiliensis, 19-21, 28
Hicriopteris, 40
Horne, William T., 78
Hurricane, Damage to trees in New York City in the, 66
Hyacinthus, 49
Hydrocotyle mexicana, 65; *umbellata,* 65
Hymenocallis littoralis, 64

Incompatibilities, Inactivation of, in tetraploid progenies of *Petunia axillaris,* 45, 76
Isoetes, sp., 60

Johnson, Marion A., On the shoot apex of the cycades, 52, 76
Juncus effusus, 64; *marginatus,* 64
Jussiaea peruviana, 65; *repens,* 65; *suffruticosa,* 65

Knobloch, Irving W., New plant records for the Niagara frontier, 59

Linum, 34
Loomis, H. F. & Heuer, J. H., Improved rooting of Cryptostegia cuttings callused on the plant, 8
Lophocolea heterophylla, 59

Macrozamia, 52, 56; *Moorii,* 53
Maranthrum foeniculaceum, 65; *Schiedeanum,* 65
Marie-Victorin, Frère, 78
Mariola, 23
Mariscus jamaicensis, 64
Marsilia sp., 61
Metzner, Jerome, The morphology, cytology, and taxonomy of *Volvox,* lecture, 42
Microcycas, 52, 56; *calocoma,* 53, 55
Microstylis unifolia, 60
Monstera deliciosa 14, 15
Muenscher, W. C., Observations on the distribution of some aquatic plants in Guatemala, 61

Najas, 61; *guadalupensis,* 62; var. *curassavica,* 62
Nasturtium officinale, 65
Niagara frontier, new plant records for, 59
Nymphaea ampla, 65
Nyssa sylvatica, 72

Oenothera organensis, 49; *rhombipetala,* 49
Officers of the Club for 1944, 13, 14

Pachysandra, 77
Panicum paludivagum, 63
Parthenium argentatum, 21
Paspalum virgatum, 63
Penicillin, 12, 37
Penicillium notatum, 12, 37; *rugulosum,* 12
Petunia axillaris, 45-47, 49, 50; Inactivation of incompatibilities in tetraploid progenies of, 45; *nyctaginiflora,* 45, 50
Phormidium tenue, 59
Phragmites communis, 63
Phymatotrichum, 12
Pistia stratiotes, 64
Plant records for the Niagara frontier, 59
Platanus acerifolia, 72; *orientalis,* 68
Platt, Rutherford, The mechanics of spring, lecture, 44
Plectonema nostocorum, 59
Pontederia cordata, 64; *rotundifolia,* 64
Populus Eugenei, 68; *szechuanica,* 68
Potamogeton foliosus var. *genuinus,* 62; *fragillimus,* 62; *gramineus* var. *graminifolius,* 62; *nodosus,* 62; *pusillus,* 62
Proceedings of the Club:
Dec. 7, 1943, 12 Jan. 4, 1944, 13
Dec. 15, 1943, 13 Jan. 19, 1944, 14

Feb. 1, 1944, 15
Feb. 16, 1944, 39
Mar. 7, 1944, 40
Mar. 15, 1944, 40
Apr. 4, 1944, 42
Apr. 19, 1944, 42
May 2, 1944, 43
May 17, 1944, 76
Oct. 3, 1944, 76
Prunus, 49; *serotina*, 72
Pseudolarix amabilis, 68
Pueraria Thunbergiana, 34

Quercus palustris, 72

Rehder, Alfred, On the concept of type, 6
Review: Allard H. A. & Leonard, E. C., The vegetation and floristics of Bull Run Mountain, Virginia, 36
Rhizophora Mangle, 65
Rhizophydium coronum, 31.
Rhododendron lincarifolium, 6; *macrosepalum*, 6, 7
Rice, Myron Arthur, Notes on *Spergularia*, 74
Robinia Pseudoacacia, 68, 70
Rosa Roxburghii, 7; *xanthina*, 7
Rubber, Western Hemisphere natural, 17
Ruppia maritima, 62

Sagittaria lancifolia, 62
Salvinia rotundifolia, 61
Schizothrix calcicola, 59; *lacustris*, 59
Scirpus californicus, 64; *cubensis*, 64
Scleria latifolia, 64; *microcarpa*, 64
Scorzonera, 27
Shoot apex of the cycads, 52, 76
Shull, George H., Some genetical studies with *Capsella*, lecture, 42
Solidago altissma, 24; *gigantea*, 24; *leavenworthii*, 24; *sempervirens*, 24
Spergularia, Notes on, 74; *alata*, 74, 75; *media*, 74, 75
Spiraea prunifolia, 7
Stangeria, 56
Sticherus Intermedius, 40
Stout, A. B., Inactivation of incompatibilities in tetraploid progenies of *Petunia axillaris*, 45, 76
Streptopus amplexifolius, 60
Svenson, H. K., Through the flowering season at the Brooklyn Botanic Garden, lecture, 39

Taraxacum kok-saghyz, 14, 24-28
Tephrosia, 1, 2
Thalassia testudinum, 63
Thom, Charles, A mycologist looks at antibiotics, especially penicillin, lecture, 12
Tilia tomentosa, 72
Treasurer's Report for 1943, 16
Trichocerus spachianus, 53
Trichoderma, 12
Trifolium, 34
Tristicha hypnoides, 65
Tulipa, 49
Type, On the concept of, 6
Typha truxillensis, 62

Ulmus procera, 72; *pumila*, 68
Utricularia obtusa, 65

Vallisneria americana, 63
Volvox, Morphology, cytology, and taxonomy of, lecture, 42; *aureus*, 42; *Carteri* var. *Hazeni*, 42; var. *homothallicus*, 43; *globator*, 42; *Migula*, 43; *mononae*, 43; *tertius*, 42

Whaley, W. Gordon, 16; Western Hemisphere natural rubber, 17
Wood products conference, 78

Yuncker, T. G., *Cuscuta japonica* Choisy, an Asiatic species new to America, 34

Zamia, 52, 54; *integrifolia*, 53; *latifolia*, 56; *silvicola*, 55; *umbrosa*, 56

ERRATA

p. 27, l. 24, for *Asclepias syrica* read *A. syriaca.*
p. 32, l. 17, for **Catenochytrium** read **Catenochytridium.**
p. 42, l. 7, for Schull, read Shull.

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THE MEMOIRS, established 1889, are published at irregular intervals. Volumes 1-19 are now completed. Volume 17, containing Proceedings of the Semi-Centennial Anniversary of the Club, 490 pages, was issued in 1918, price $5.00.

Volume 19, no. 1, 92 pages, 1937, price $1.50. Volume 19, no. 2, 178 pages, 1938, price $2.00. Volume 19, no. 3, 76 pages, 1940, price $1.25. Volume 19, no. 4, 58 pages, 1941. Volume 19 complete, price $5.00.

Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

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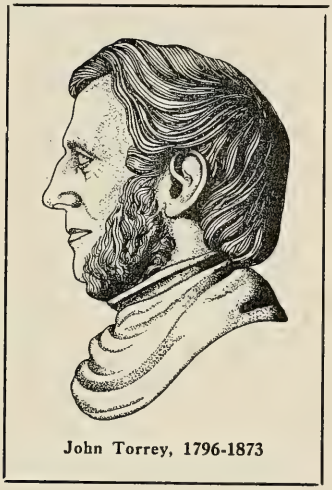

John Torrey, 1796-1873

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BY

HAROLD H. CLUM

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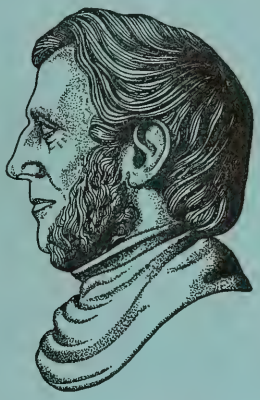

John Torrey, 1796-1873

CONTENTS

Alternations of Generations and Classification With Special Reference to the Teaching of Elementary Botany ..... Herbert A. Wahl 1

An Abnormal Balsam Fir ..... David B. Cook 13

Book Reviews

Pathology in Forest Practice ..... E. W. Littlefield 15

Foundations of Plant Geography ..... Herbert L. Mason 17

Field Trips of the Club 21

Proceedings of the Club 27

News Notes 32

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TORREYA

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Alternation of Generations and Classification With Special Reference to the Teaching of Elementary Botany*

HERBERT A. WAHL

The value of a scientific theory is usually directly proportional to the amount of thought and investigation which it stimulates. A theory loses its value when it becomes so generally accepted that the implications of the theory are considered as facts and stimulation of thought passes over to unquestioned acceptance of ideas as facts. Since what seems to be a fact in the light of certain evidence may lose its factual nature in the light of supplementary evidence, the periodic reexamination of established ideas is a constant scientific desideratum. This has been aptly expressed by Parkin and quoted by Douglas (1944) as follows: "It is well that from time to time there should be a stocktaking—a full appraisment of our botanical generalizations."

The various expressions of the phenomenon of Alternation of Generations as it occurs in the plant kingdom, while mostly in the realm of fact rather than of theory, embody various theoretical considerations some of which have become so well established as to be accepted as fact. Yet, in the light of accumulated evidence, they may now require additional appraisal.

It has long been recognized that the life cycle of vascular plants and bryophytes, as well as of many algae, consists of an alternation between two phases or generations each of which by a characteristic reproductive process initiates the other. These two growth phases or generations have constantly been referred to as the sporophytic phase or sporophyte and the gametophytic phase or gametophyte, since the former is spore-producing and the latter is gamete-producing. Further, it has been recognized since the time of Strasburger that the number of chromosomes in sporophytic nuclei is characteristically double that in gametophytic nuclei. The chromosome number is doubled by the fusion of gametes, the process that initiates the sporophytic phase, and halved by meiosis, the process which initiates the gametophytic phase.

Theories of alternation of generations deal chiefly with the origin and development of the phenomenon. One school of thought has maintained that the alternating generations are antithetic in their origin, that is, that the sporophytic generation arose by a gradual evolutionary development of the zygote following sexual reproduction and is a new structure not homologous in origin

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with the gametophyte, which was the original structure. The other school of thought has maintained that the two generations are parts of an original gametophytic generation, one part of which became spore-producing while the other part retained its gamete-producing function, thus giving rise to generations which are homologous in origin. The term homologous alternation of generations is used in two ways, however; in one sense to indicate the homologous origin of the generations and in another sense to indicate generations which are alike in appearance (isomorphic). It is not the purpose here to review the merits of the antithetic and homologous theories of alternation. Most of the references are to older literature and will be found in Svedelius (1927) as well as in current textbooks on plant morphology. The bearing of the present concept on the problem will be referred to in the latter part of this paper.

The phase of the phenomenon which has been widely accepted and which it is here considered may need revision is the application of the term "asexual" to the sporophytic generation and to its characteristic and "normal" method of reproduction, that is, by spores produced by the process of meiosis. This usage may depend, in the first place, upon one's definition of or understanding of what constitutes sexual and asexual reproduction. If the term sexual reproduction is to be used only to refer to the initiation of a new individual or generation of a life cycle by the fusion of cells, and if asexual reproduction is to be used to include all cases in which a new individual or a generation of a life cycle is initiated without such fusion, regardless of whether the same or another generation is thus initiated, then, by definition, the alternating generations in the life cycle of plants are sexually and asexually reproducing generations. Sexual and asexual reproduction have long been considered in the above manner, this is, the former as being characterized by a fusion of cells and the latter by a lack of fusion.

Selecting from the older literature we find the viewpoint that the sporophyte and gametophyte represent, respectively, asexual and sexual generations concisely expressed in an oft-quoted paper by Davis (1903). "The gametophyte is the sexual plant, developing the sexual cells or gametes. The sporophyte is asexual, producing spores." However, if we continue to follow the discussion in the same paper, we find expressed the state of knowledge which existed at that time concerning the chromosomes and their behavior. "If the question is asked why are the chromosomes so important and why should their number be so significant, no answer can be very satisfactory for our deep ignorance of the nucleus is exposed." "We do not know what the chromosome does——." "It will thus be seen that there can be no genetic relationship between the reduction phenomena of higher plants and animals. They are not found at the same points in the life history and there are also fundamental differences in the details of the process——." "——there is no reduction phenomena in plants at the time when sexual cells are formed——." "The

fact that the number of spores formed in each mother cell is four appears to have no important morphological significance. It has no connection with reduction phenomena which—take place before these divisions." Obviously, our knowledge of chromosome function and behavior has increased greatly since the above excerpts were first written. It seems equally obvious, however, that this knowledge has not been applied, or has been indifferently applied, in an interpretation of the relation of these phenomena to the sexual life cycle of plants.

It should by now be apparent that the process of sexual reproduction involves not only the fusion of gametes (syngamy) by which the zygote receives the sum of the chromosomal components of the two gametes, but that the process by which the chromosome number is reduced (meiosis) is an integral part of the sexual life cycle. In animals generally and in those plants (*Fucus,* diatoms, Siphonales) in which meiosis shortly precedes syngamy, this relationship is obvious. In most green algae and in other Thallophyta in which meiosis follows syngamy without the intervention of a growth phase or alternating generation, the relation should be equally obvious. In those plants in which a growth phase intervenes between syngamy and meiosis, that is, in which an alternation of generations occurs, the separation of syngamy and meiosis in point of time seems to have been instrumental in the frequent failure to associate the processes as integral parts of the sexual mechanism.

The difficulties which arise from the dissociation of the meiotic processes and syngamy and the association of meiosis with asexual reproduction have their beginning, as far as elementary teaching is concerned, in a consideration of the reproductive processes in the lower plant groups. In many algae, vegetative (asexual) reproductive cells such as zoospores, aplanospores, etc., are produced by the haploid plant body while the same plant body produces gametes. Following the fusion of gametes, the next reproductive process in the life cycle of many common algae is the meiotic division of the nucleus of the zygote, a process which results in the production of four spores. Since asexual reproduction has consistently been considered as including all reproductive processes not directly initiated by a fusion of cells and since it refers especially to the production of spores, the tendency here is purposely or passively to homologize the vegetatively-produced spores with the spores produced as a result of meiosis. The vegetative production of spores is exactly comparable as a reproductive method to the production of gemmae by liverworts and mosses and to the production of gemmae, bulblets and the host of other vegetative reproductive devices by vascular plants. The reproductive methods are entirely comparable regardless of the fact that we are here comparing processes of the gametophyte with those of the sporophyte; they all consist of the rejuvenation of an individual by the initiation of growth from some more or less specialized portion of the vegetative plant body. In some algae in which an alternation of generations occurs (e.g. *Cladophora*)

vegetative spores are produced by both generations, those produced by the haploid generation producing haploid plants and those produced by the diploid generation producing diploid plants.

Of an entirely different nature are those cells (meiospores) produced by vascular and non-vascular plants as a result of meiosis. These are not vegetatively produced; they are produced only by organisms having sexual reproduction and their production represents a continuation of the sexual process. They do not produce the generation from which they originated but having been formed as a result of a reproductive process in a diploid generation, the product of their growth is a haploid generation. In some cases (diatoms, Siphonales) they may be the only haploid cells; they are, functionally, gametes. They are fundamentally different from vegetative spores (zoospores, aplanospores, etc.); in no sense are the two kinds of so-called spores homologous. How then can the term asexual reproduction be used to refer to reproduction by these entirely different methods?

That it is so used is evident from the treatments in most of the numerous current textbooks covering the field of Elementary Botany. In almost all of these that the author has examined, no clear distinction is made between the actual nature of vegetative spores and meiospores. The production of both and the initiation of a new individual by their growth is generally included under the term asexual reproduction. These two kinds of reproductive structures, one strictly vegetative and the other associated with sexual reproduction are homologized either directly or by inference. In most cases the gametophyte is described as a sexual generation because it produces gametes and the sporophyte as an asexual generation because it produces spores and the same terminology is used to describe vegetative spores and meiospores. In one of the more recent texts (Smith et al., 1942), the term asexual reproduction is entirely eliminated but even here the reader is led to infer that the spores produced by meiosis are in the same category as the vegetatively-produced spores of green algae, since no effort is made to distinguish between them.

Although the author has not attempted to be exhaustive in his review of the numerous current elementary textbooks, a majority of those published in the United States have been examined. In only three of these is sexual reproduction used in the sense of referring to the complete reproductive life cycle. In the relatively brief and elementary textbook by Chamberlain (1930) "gametic reproduction" is considered as including the complete reproductive process, consisting of the fusion of gametes and the consequent production of the original plant by meiospores (Fig. 147). Even here, however, the same term, zoospore, is used to denote both vegetatively produced spores and meiospores so that confusion between the fundamentally different reproductive processes by which they are produced is made easy in the mind of the student.

In a more recent text (Weatherwax, 1942), one that is also intended for use in a shorter course, the author considers the production of meiospores as part of sexual reproduction. "The complete sexual life cycle consists of two generations, the gametophyte and the sporophyte, which follow each other in alternate sequence." (p. 196.)

It is refreshing to note that this viewpoint which considers a life cycle involving an alternation between a gametophytic phase and a sporophytic phase as a sexual life cycle is at least partially maintained in one of the more extensive modern elementary texts (Transeau, Sampson and Tiffany, 1940). In discussing reproduction in *Ulothrix* the authors state: "The special method of vegetative multiplication by means of either motile or non-motile spores which are formed without a previous union of gametes is often termed *asexual reproduction*. The related series of processes including the formation of gametes, their subsequent union, and the development of the resulting zygote into motile spores from which new filaments develop are referred to as the sexual reproduction of the algae." The life cycle of flowering plants is also considered a sexual life cycle and by inference the sporophyte is as much a sexual individual are are the gametophytes. It is a bit disconcerting, however, to find under the discussion of liverworts the heading "The sporophyte and asexual reproduction" leading to the inference that here the production of meiospores is not part of sexual reproduction and that the sporophyte is an asexual generation.

The above mentioned cases constitute the exception. From a consideration of other books, it is apparent that the student is in most cases introduced to the idea that following sexual reproduction (fusion of gametes, or syngamy) an asexual reproductive process (production of spores by meiosis) occurs. This must be expanded in the higher plants to include the idea of alternating sexual and asexual generations with their concomitant methods of sexual and asexual reproduction. The elaboration of the idea of alternating sexual and asexual reproductive methods by Coulter (1914) has probably been of greater importance in perpetuating this concept than any other work.

Several disadvantages of this viewpoint may here be pointed out. In the first place, the concept of a life cycle involving an alternation of sexual and asexual reproduction and sexual and asexual generations is inherently more difficult for the beginner to grasp than the same series of events explained in terms of a continuous process as a sexual life cycle. Let it not be thought, however, that the present author would condone any presentation which merely substitutes simplicity for correctness. The greater simplicity of considering the life cycle a sexual cycle has been demonstrated in class work. The assumption that the viewpoint is correct is based, of course, not on new facts but on an evaluation of accumulated ideas.

In the second place, the consideration of the sporophyte as an asexual generation and the production of spores by meiosis as an asexual process leads

naturally to a comparison and homologizing of vegetatively-produced spores of algae with meiospores, though the two are fundamentally and entirely unlike in their significance in the reproductive life cycle. This has been referred to earlier in the present paper.

Thirdly, the consideration of reproduction by spores produced by meiosis as a strictly asexual process in contrast to sexual reproduction by the fusion of gametes has tended to dissociate the two cytogically important processes in the life cycle;—syngamy and meiosis. Too often in elementary (and advanced) texts the reduction in chromosome number which occurs at meiosis is considered as occurring during *a division* which is *contrasted with an ordinary cell division* (mitosis). It is generally recognized that the reduction in chromosome number occurs during a series of *two* divisions; that the term, *a reduction division,* is decidedly a misnomer. It is well known, even by those who are responsible for statements in textbooks such as "—in reduction division—the chromosomes do not split at all—", that the chromosomes *do* split during the first meiotic division. But this is done in an attempt to contrast "reduction division" with mitosis, since "—in ordinary cell division the chromosomes split longitudinally—." Now the reduction in chromosome number is not a process to be contrasted with mitosis, since it itself may be considered as consisting of two mitoses (Sharp, 1934, Chap. 16), but is a process to be contrasted with syngamy. Meiosis is not simply a type of cell division but represents the culmination of the sexual process which is initiated by the fusion of gametes. The process of syngamy introduces the two sets of chromosomes into one nucleus. The final association of the chromosomes during which there occurs not only an intimate association (synapsis) but even an interchange of parts (chiasmata formation; crossing over) takes place during meiosis, the culminating feature of sexual reproduction. The sporophytic generation is an interlude in the sexual process. The sporophyte is a sexual generation. The meiotic production of spores and the growth of a new individual from each is part of the process of sexual reproduction.

In advanced texts dealing with the groups of plants, the viewpoints are variable. Fritsch (1935) distinguishes between the significance of zoospores from the haploid plant and those from the zygote, since in discussing the life cycles of Algae he says, "—in addition to reproducing by sexual means it (the gametophyte) may also exhibit abundant asexual reproduction. This latter is, however, actually an accesory means of reproduction and, in relation to the general course of the life cycle, has not the same significance as the formation of asexual swarmers or other reproductive cells from the zygote which ensues after the occurrence of meiosis." (p. 51). The distinction is not clearly followed, however, since the production of asexual spores (zoospores, aplanospores, etc.) by the gametophyte and the production of spores from the zygote by meiosis are both considered under the discussion of asexual reproduction and

no mention is made of the latter in what is here considered their proper relation, that is, as part of the sexual process. The sporophyte is considered an asexual generation and the production of meiospores is considered an asexual process. In fact, in a previous paragraph (p. 41) the statement is made that "Of a comparable nature to aplanospores are the endospores formed in certain Myxophyceae and the tetraspores of Rhodophyceae and Dictyotales." This may be meant to refer only to their method of formation, however, and not to their significance in the life cycle.

Although Fritsch's book is not intended for use in elementary courses in general botany, the above quotations serve to emphasize the difficulties that arise with beginning students when a life cycle is considered as consisting of an alternation between a sexual and an asexual phase in which the sexual phase may also reproduce asexually, and in which the asexual phase may also reproduce by other asexual or vegetative methods which have not the same significance as its "normal" method of reproduction. How much simpler, and more correct, to consider the sexual life cycle as including syngamy and meiosis, with the interpolation of growth phases, either or both of which may have vegetative (asexual) methods of reproduction.

Smith (1933, 1938a), in his treatments of the Algae, generally considers the meiotic production of spores under the heading of asexual reproduction, except where meiosis shortly precedes syngamy, as in *Fucus,* in which case it is part of the sexual process. He does, however, distinguish, in some brown algae, between meiospores and vegetative spores, designating the latter as "neutral" spores since they produce the same type of plant from which they originate. In the case of *Fucus,* it seems at least as logical to consider the plant a gametophyte in which meiosis has been delayed until the production of gametes, the sporophytic generation having been eliminated or never produced, as to consider a plant that produces cells which function as gametes a sporophyte because the cells of the plant are diploid.

In his treatment of the bryophytes and pteridophytes, Smith (1938b) definitely considers the gametophyte a sexual generation and the sporophyte an asexual generation, although he describes the gametophytes as also reproducing asexually by gemmae and by other vegetative methods. The same viewpoint is expressed by Campbell (1918) in his "Mosses and Ferns."

Tilden (1935), on the other hand, considers the alternation of generations as an alternation between sexual generations. "*Sexual reproduction,* in the plant and animal kingdom includes, or has to do with, the entire normal life cycle, consisting of a morphological or cytological alternation of haploid and diploid generations. The sporophyte is as much a sexual organism as is the gametophyte, since it carries in its body the sex-bearing chromosomes" (p. 236). She restricts the use of the term spore to reproductive cells which are the products of meiosis, and this process is considered part of sexual reproduction. "Sexual

reproductive bodies include gametes and spores." For the vegetative (asexual) "spores" of algae (zoospores, aplanospores, etc.) she uses the term *gonidia.* These may be either motile (planogonidia) or non-motile (aplanogonidia).

In discussions of alternation of generations other than in textbooks, the viewpoint that the sporophyte should be considered a sexual generation has been maintained by Chamberlain (1905) and by Svedelius (1927). The latter, after referring particularly to the life cycle of *Fucus* makes the following statement: "From this it is evident how misleading it is to characterize the alternation of generations as an alternation between sexual and sexless generations. On the contrary, it is a characteristic feature of this evolutionary process that in the course of the increasing disparity of the generations in the direction of the dominance of the sporophyte, sexuality passes over more and more to the originally 'sexless' generation." To this it may be added that the "sexless" generation need no longer be considered as having been even originally sexless since, as Svedelius himself states in a later paragraph, "In a certain measure reduction is to be regarded as the final act and the goal of fertilization." It is becoming ever more apparent that reduction (meiosis) and fertilization (syngamy) are actually and inseparably both involved in the ordinary process of sexual reproduction, together with the generations which precede and initiate them.

In the voluminous literature referring to sex determination in plants, the sporophytic generation is regularly referred to as exhibiting features of sexuality. Indeed the very term "sex determination" as it is ordinarily applied to angiosperms, would otherwise be meaningless. "Any genetic analysis of sex in angiosperms must deal almost exclusively with characters of the so-called asexual generation, since those of the much-reduced haploid 'sexual' generation have yet afforded little material for genetic study. To speak of sexual characters in an asexual generation is paradoxical; but the paradox inheres in the terminology, not in the facts" (Allen, 1932, pp. 97-98). This viewpoint is accepted by Loehwing (1938).

Thus occurs a paradox in scientific terminology whereby a term in general use admittedly is not even intended to mean what its definition implies. For those who have been "brought up" on such usage to continue to use it while admitting its incorrectness may be in slight degree justifiable; to continue to "bring up" succeeding generations of botanists on an admittedly incorrect viewpoint because of the unwillingness of textbook writers (and I suppose of many teachers) to incorporate new ideas into their teaching is not consistent with the best scientific practice.

The question of terminolgy then arises in connection with the consideration of the sporophyte as a sexual generation. Sharp (1925) has discussed terms to be used in implying sexuality to the sporophyte and it may be useful to have a set of terms separate from those applied to the gametophyte. We are

here concerned, however, only with those reproductive terms constantly used in an elementary presentation. We have already called attention to the confusion that may result when the term asexual reproduction is used in connection with vegetative reproductive processes and with the production of meiospores. Since the latter is part of sexual reproduction, since the term vegetative reproduction adequately describes the former and since asexual reproduction has been used to denote entirely different processes, it would seem best to discontinue use of the term asexual reproduction entirely. This, as before mentioned, has been done in one recent text. Tilden (1935) uses the term *spore* only for meiospores and the term *gonidium* for vegetatively produced spores. It seems more expedient to the author to continue the use of the term spore for both of these categories, simply recognizing that meiospores (including ascospores and basidiospores) are sexual spores while other kinds of spores are vegetatively produced. Spores, then, are usually one-celled reproductive bodies which produce new plants by direct growth, in contrast to gametes which are one-celled reproductive bodies which fuse together. For the purpose of teaching Elementary Botany it is unfortunate that there exist in the plant kingdom such a multiplicity of kinds of spores. The facts make necessary the application of numerous prefixes to describe certain types of spores such as zoospores, conidiospores, uredospores, meiospores, etc., etc. The problem is not simplified by failing to recognize that some of these are vegetatively produced while others are involved in the sexual reproductive processes.

We may now comment briefly concerning the bearing of the ideas presented in this paper on the relative merits of the antithetic and homologous theories of alternation of generations. Fritsch has been one of the leading proponents of the idea that the origin of the alternating generations, at least as they occur in members of the Pteridophyta, is to be sought in the type of algal plant body which occurs in certain members of the Chaetophorales of the Green Algae. Members of this group exhibit the heterotrichous type of plant body which consists of a prostrate creeping system, often more or less pseudoparenchymatous, and a more or less upright system of usually branching filaments. In some cases (e.g., *Trentepholia*) zoospore production is confined to the upright system and gamete production to the prostrate system.

According to Fritsch (1916, p. 240) this condition provides "all the necessary indications for the gradual differentiation of two alternating generations, of which one bears the asexual organs on the upright system, the other bears the sexual organs on the creeping base. Disappearance of the base in the former, and of the upright system in the latter—will give two different generations, resembling those of the Archegoniatae in all respects." This is incidentally referred to again in a later paper (1920, p. 170). "An alternation between sexual and asexual phases must have come about as soon as the reduc-

tion-division became associated with spore-formation—." He then refers to the "relegation of the reduction-division to the time of spore formation." Herein is expressed a fallacy to which we readily fall heir when the alternating gametophytic and sporophytic generations are considered as being respectively sexual and asexual; a fallacy which is inherent in any theory of the homologous origin of the alternating generations. This line of reasoning directly and purposefully homologizes meiospores, which are always and only produced during the series of processes involved in sexual reproduction, with the vegetatively produced spores of algae. It postulates an origin of the meiotic processes in connection with the vegetative production of spores rather than confining it to the only conceivable place in which it could possibly have a function, namely, as a result of the process in which the chromosome number is doubled. Meiospores can have no homologous identity with vegetative spores. The latter are considered by many to be homologous with gametes, since the usual theory of the origin of sexual reproduction considers that gametes are modified vegetative spores. It is altogether logical that the cells produced as a result of the meiotic processes following sexual fusion in various primitive plants should simulate in appearance the vegetative spores produced by that particular plant, since new genes for the production of somatic characters would not necessarily be produced at the same time that sexual reproduction had its origin. But to consider these cells as being homologous in origin would be comparable to considering as homologous the leaves of mosses and of lycopods, or root hairs of vascular plants and rhizoids of fern prothallia. From the viewpoint of the present paper, therefore, the alternating generations in a sexual life cycle such as occur in all plants above the Thallophyta, and in many Thallophyta, could not be considered as having had a homologous origin.

This paper has thus far attempted to show that the usual textbook presentation of the "asexual" nature of the sporophyte should be corrected in favor of considering the alternating generations in the life cycle of plants as parts of the sexual life cycle. Although both viewpoints are to be found in current texts, the former has the weight of numbers and the sanction of long continued usage. Of even greater uniformity both from the standpoint of unanimity of presentation and of admitted incorrectness is that part of most botanical texts which serves, or should serve, the dual purposes of presenting the groups of plants in an orderly sequence and of indicating the supposed relationships between the groups,—the system of classification. The time-honored system of Thallophyta, Bryophyta, Pteridophyta and Spermatophyta serves the first of these purposes but lacks woefully in serving the second, especially as between the groups included in the last two divisions. It has been expressed as a truism that no morphologist considers the ferns, lycopods and horsetails closely related. Yet, in the great majority of elementary texts the lycopods and horsetails are "the allies of the ferns." The fact that this system

"has been so generally adopted" (in the past) does not argue in its favor since it is well recognized that it does not express the present state of knowledge regarding plant relationships.

Systems of classification reflecting modern ideas of relationships in the entire plant kingdom have been prepared among others by Copeland (1938), Barkley (1939), and Tippo (1942). The systems here referred to certainly are not to be considered "new" at this time since they draw on a wealth of morphological knowledge, most of which has been available for two decades or more. Neither are they only the opinions of their respective authors, since they represent the accumulated efforts and opinions of many specialists in various groups. Herein lies one of their best recommendations. Yet at the present time hardly an elementary textbook even mentions these ideas without apologies! Where would genetics or plant physiology be if similar accumulations of ideas in these fields were studiously withheld until they had mellowed for a quarter of a century?

Why do elementary texts shy away from the presentation of such accumulated knowledge? The usual claim that the older system is easier is only partially true. One system of classification is not easier than another for a beginner. It is only the one who has been used to the older system who would have difficulty in making a change. "Easier," then, can only mean that it is easier for the teacher, not that it is easier for the student.

This leads naturally to the conclusion that textbooks are written for the convenience of the teacher rather than for the information of the student;—that pedogogy is for the pedagog rather than for the learner. Such a conclusion, is, of course, not valid for the majority of the subject matter in most textbooks available at the present time. But what other reason could be assumed when an author, for example, relegates an admittedly "modern" system of classification to an appendix while using an admittedly outmoded system in the body of the text? Or when an author admits that "a better classification" separates plants into groups other than those with which he has tried to make the student familiar?

It seems apparent that modern textbooks of elementary botany have been "leaning over backward" in an effort to maintain a conservative viewpoint in the field generally designated as Comparative Morphology. Although there may be room for divergence of opinion as to the relative emphasis to be placed on the various materials presented to beginning students, especially in the briefer courses, there seems to be no tendency to exclude a consideration of the comparative structural and reproductive features of the 15 to 18 groups (usually classes) of plants ordinarily considered as constituting a fair representation of the plant kingdom. This usually (but not necessarily) involves classification and life cycles. If a system of classification is to be presented, why not let it reflect modern ideas of relationships? If life cycles are thought desirable, a con-

sideration of the complete life cycle as a sexual process may focus attention more forcefully on the genetical aspects of chromosome behavior and may serve to modify their "prolonged and prayerful consideration" in the direction of greater simplicity and proper scientific evaluation.

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An Abnormal Balsam Fir

David B. Cook

Unusual growth forms of trees are of interest to the cytologist and the geneticist as well as to the general botanist. Some atypical forms have commercial or horticultural value, others are mere curiosities. Among the Pinaceae, variations are usually minor and mostly concern twig placement and foliage color.

W. H. Bennett has reported (Quarterly Journal of Forestry, **30** (1): 133-134. 1936) on a Norway spruce which, for four seasons after planting, produced normal lateral branches; then, for the succeeding six years (up to the date of writing) grew a single, branchless, upright stem. No explanation for the phenomenon is suggested.

During a recent field trip, my associate, Mr. Stacy B. Robeson of Plattsburg, N. Y., showed me an unusual specimen of balsam fir (*Abies balsamea* (L.) Mill.) on Valcour Island in Lake Champlain. The tree is growing at the east edge of a woods of white spruce, white cedar and fir, on thin soil underlaid by limestone. This specimen is abnormal in that there is no indication that lateral buds have ever been produced. As a result, the tree is *entirely devoid of branches.* At the end of the 1944 growing season, the total height of this single, branchless stem was 85 inches. The diameter just above the ground was 0.54 inches; at the base of the 1944 internode, 0.32 inches. The nodes are marked by distinct ridges in the bark and by a frill of needles, when present. They indicate a total age of 20 years. The longest internode (1939) is 8.5 inches, that of the 1944 season 5.6 inches. The 1936 internode is the oldest one still bearing needles. The distribution of foliage is the same as that on normal leaders. Needles are of normal length but *strongly* keeled and with a *pointed* tip. The terminal bud is bluntly conical and as big as the end of the leader.

Considering the small amount of foliage, height growth is good. But diameter growth is deficient and the stem is so slender that it does not stand erect, as will be seen in the accompanying figure.

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Albany, New York

An abnormal balsam fir. Valcour Island, N. Y., 1944.

BOOK REVIEWS

Biological Management of the Forest

Pathology in Forest Practice. By Dow Vawter Baxter. 618 pp., illustrated, with chapter bibliographies, and index. New York: John Wiley & Sons. 1943. $5.50.

As its title implies, this work is written for the practising forester—for the individual who wants specific answers to concrete problems in forest pathology. It is hardly a book for the layman, assuming, as it does, a basic knowledge of forest science and technique. But for the advanced student, the forest nurseryman, the silviculturist, or the person employed in the handling of forest products, it should prove an invaluable reference work.

The approach undertaken here to the pathology of the forest is entirely original, and may well mark a turning point in the literature of the field. Here, for the first time, emphasis is placed solidly on the forest community (whether nursery, woodland or plantation), rather than on pathogenic organisms associated with disease symptoms. Such emphasis would appear to be in line with the more advanced trends of present-day medical thinking, where patients rather than diseases, have become the principal objects of concern. Thus, in a book of some 600 pages, less than 50 are devoted to the chapter entitled: "The Fungi which Cause Disease." From here on the treatment is functional, under such headings as: damage appraisal, nursery, plantations, cultural practices, shade trees, and forest products—each in relation to disease incidence, character of injury, extent of losses, and control methods. This arrangement involves a certain amount of recapitulation both in the discussion and in the bibliographies appearing at the end of each chapter. While thus adding considerably to the bulk of the work, it has increased the availability of the material to the practitioner many-fold.

According to the thesis developed by Dr. Baxter, disease incidence results less from the pathogenicity of fungous organisms than from environmental conditions (natural or induced by improper cultural practices) which pre-dispose to infection. In addition, numerous states of "disease" are recognized in which attacking organisms other than fungi are involved, or where a disturbed metabolism of the tree is alone responsible. In discussing these so-called "physiological diseases," the role of soil and climatic influences is admirably portrayed.

Few pathologists in the country, today, possess the background of forestry and forest practice to have assembled this material; fewer still would have had the courage to present it in a form so completely divorced from the traditional concepts of plant pathology. As a natural result of the emphasis laid upon forest practices, the book includes a wealth of data concerned with var-

ious phases of nursery and planting technique and with methods of harvesting and regeneration in the woods. In fact, the title: "Biological Management of the Forest," would be none too broad for the field covered.

In its geographic range, the book is thoroughly cosmopolitan, in line with the author's well-known fondness for travel; frequent references are thus made to conditions in the different regions of North America and to Europe, which Dr. Baxter knows at first-hand. At the same time, there is a strong "mid-western" tinge to the work, and particularly in the sections dealing with the forest nursery and plantations, a rather large proportion of the case-histories is taken from the Lake States. From the easterner's point of view this has led to a few lapses, such as the footnote on p. 140 where, in citing the number of acres planted in the Lake States region in 1937 there is appended the remark: "Other agencies also planted trees during this period." This is indeed a conservative statement, when one considers the extent of the reforestation projects in New York and other eastern states during the thirties.

Special mention should be made of chapter VIII: "Relation of site and care of shade and park trees to disease incidence," which occupies pp. 387-484. There is some question, in this reviewer's mind, whether, in a book dealing primarily with "woods forestry," nearly 100 pages should have been devoted to shade trees—especially, when so many standard texts are available on the subject. The insertion of this chapter was doubtless thought necessary, since foresters, wherever found, are always expected to lend professional advice to owners of ailing shade trees. From this standpoint the material is adequate enough, though insect troubles are, of course, not included, making the section seem incomplete in comparison with the special works. Numerous diseases and injuries are described, including that from use of spray materials; in this latter connection, most of the attention is naturally given to fungicides. For this reason, apparently, no mention is made of injury from dormant-oil insect sprays, which has given arborists so much concern in recent years.

One of the unusual features of the book is the section (pp. 208-210) on rubber-plantations, having special reference to root-rot and its treatment. Mention should be made, also, of the superb illustrations which amplify every feature of the text: unique among these is the photo (p. 408) of twigs covered with ice after a glaze storm.

To summarize: Here is a work both scholarly and practical; a sound biological treatise and an extremely useful handbook, within the same text. It should become the inseparable companion of all who seek a better understanding of the forest, or who would apply forestry principles with a minimum of avoidable errors.

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E. W. Littlefield

Plant Geography

Foundations of Plant Geography. By Stanley A. Cain. xiv + 556 pages. Harper and Brothers. 1944. $5.00.

The spirit of science demands that every theory be forced to justify its existence and that our philosophy be constantly revised that it may always be in keeping with the advances in our knowledge. "The Foundations of Plant Geography" by Stanley A. Cain attempts to reconcile the thinking in plant geography to the very great advances in our knowledge in the several contributing fields, and surveys the research methods in these fields. There is brought together in one volume a mass of material representing the significant thought on all sides of the many problems bearing on the dynamics of plant distribution. In some instances the author writes as an able reporter, in other instances he chooses to comment upon or synthesize and review the subject matter. Much of this is done superbly and with a clarity that enables one to evaluate as never before the scientific worth of many of our ideologies.

The work is divided into five parts, each dealing with a distinct approach to research in plant geography. Part one attempts to orient the reader and present a résumé of previous expositions of the principles of plant geography; part two deals with what the author terms paleoecology; part three is termed "areography" and concerns spacial distribution and restriction; part four treats evolution and speciation and part five elaborates the inter-relations of polyploidy and plant geography. There is no attempt at floristic description. The work aims solely at elucidating the principles underlying the dynamics of plant geography.

By way of orientation the author refers in his introduction to "descriptive plant geography" and to "interpretive plant geography." The first of these is static and furnishes a part of the materials for the second which is dynamic. The rest of the materials of interpretive geography result from integration and synthesis of the more specialized fields of botany. In addition, "physiological plant geography" is frequently mentioned in the text. Apparently the author prefers to give this subject no "more than incidental mention." In many respects this is unfortunate as some of the criticism I would make of the work hinges upon problems that are physiological in scope or in implication.

In dealing with some previously proposed principles of plant geography and again, in discussing migration and the evolution of vegetation, the author becomes involved between two diametrically opposed concepts as to the relative significance of the means and the extremes of environmental factors in controlling the distribution of plants. According to the author, Clements maintains that the means are more significant that the extremes, whereas Mason (your reviewer) maintains that "in any given region the extremes may be more significant than the means." In attempting to resolve these divergent points of view,

the author finds himself in the awkward position of, on the one hand, agreeing with Mason and not refuting Clements, and on the other hand agreeing with Clements and not refuting Mason. The extreme is the maximum or minimum of an environmental factor beyond which functioning ceases. The mean is an abstraction pure and simple and cannot directly enter any equation of stimulus and response in the physiology of the plant. Under no circumstances is it an environmental factor. The author maintains that Clements' view is to be used "with a long time point of view and with whole associations being considered," while Mason's view is useful when individual organisms in the margin of their range are being considered. He points to the migration of the redwood forest through time as being under the influence of the migration of the mean. He admits, however, that this migration is initiated as a function of the extremes acting upon individuals. The species of the flora moved forward with permission of a change in position of the extremes and are eliminated behind under compulsion of a shift in position of the extremes. It must be pointed out that an association owes its existence to the complete or partial coincidence of the tolerance ranges of each of the component species. Hence there is no reason to assume that the behavior of an association of species will be controlled by other factors than those controlling the individuals making up the association. The author further states that the mean "characterizes associations." This is dangerously close to saying that the mean may serve as an indicator of the association. The mean of enrivonmental factors is often capable of being expressed in very definite figures, but no one has as yet discovered how these figures can be applied directly with significance to the organism. Its significance is solely as a tool of statistical computation. The problem of extremes in their action on plants is not a statistical problem.

Another point raised by the author concerns the complex problems of the interaction of factors. He points to the environment as being "holocoenotic," meaning that the factors of the environment act collectively and simultaneously. This having been stated, he proceeds to say, "It is erroneous, then, to speak of a single factor as being limiting, quite definitely, the environment is holocoenotic." I will grant that the interaction of factors complicates enormously our analysis of their operation, but I challenge the conclusion that single factors may not be limiting. The farmer in our western states goes to great expense to build an irrigation system. He knows by experience that water is a limiting factor to the plants he is growing. To be sure, water enters into many of the reactions that go on within the plant and is an agent of transport of a complex series of substances which in themselves may at times be limiting, but it is in these very functions that water may be limiting. This does not imply that water works alone nor that the processes are simple nor that any one factor is more important than any other. The fact remains that water, depending on

its availability, may at times be limiting to the successful functioning of the plant.

Carrying the idea of holocoenotic environments further, the author brings in the concept of "compensation" of factors. Here it is presumed that through the interaction of factors an adverse condition of one factor is compensated for by readjustments in the responses to other factors to meet the deficit. One naturally is curious as to how the factor can make its deficit felt to the extent of initiating compensation if a single factor cannot be limiting. In view of the genetic problems so ably discussed by the author, it would seem that the examples of extra-limital distribution used to illustrate compensation cannot be explained on the basis of compensation of factors. It would be necessary to establish beyond a reasonable doubt that the persistence through reproductive activity of any species or group of species in any given habitat is ever extra-limital. It would be more logical to seek an explanation in terms of ecotypes of one sort or another.

Considerable space is devoted to the discussion of recent work in the field of paleobotany and various methods of research are presented. Much of this paleobotanical work has not as yet been sufficiently subjected to scientific scrutiny to be properly evaluated. The author, however, does an excellent job of presenting the material. The chief difficulty is that too few minds have met over the problems involved so that in many cases the ideas expressed in the papers reviewed can scarcely be regarded as mature. In a sense the methods of the paleobotanist tend to make this difficult because the field worker, in collecting a flora, is the only one who sees the record unfold. He alone is present to evaluate the significance of the position of the material in the record. Too often he alone decides what to keep and what to discard. What he keeps often depends upon such factors as transportation and storage facilities. Any further discussion or elaboration of this flora by later workers has imposed upon it the limitations in judgment of the field collector. The preoccupation of many paleontologists with key fossils also has imposed a disastrous handicap on the values of these floras and faunas for geographic and ecologic interpretation.

In the discussion of endemism, it seems to your reviewer that the author begins with a false assumption, namely, that endemics are either youthful species or relics. What about all of those endemics in the prime of their species life that may occupy completely, all of their very specialized potential area? What about this vast array of edaphic species,—an aspect of the problem that to your reviewer seems to be of far greater significance to the general subject of endemism than is the problem of youth and old age? Is it a result of youth or old age that so many Eastern United States endemics are associated with the same ecological factors that cause pine barrens? Is it a consequence of species age that so many Californian endemics are associated with ferro-mag-

nesium rocks? Does age explain why the spectacularly endemic *Cupressus macrocarpa* of the granitic headlands of Carmel Bay stops abruptly at the contact between the Montara granite and the Monterey shale? The fact that the great majority, if not all, of the oceanic islands rich in endemics are made up either of volcanics or are rich in highly mineralized metamorphics is no chance relationship explainable solely on the bases of age and isolation. I do not wish unduly to minimize the role of youth and old age in endemism, but I am suspicious that their rôle may be much less significant than the literature would lead one to suppose. If this relationship between endemics and local habitat is as real as it appears, then such problems may well be explained from the genetic point of view. The logical approach is first to attempt to explain the occurrence of endemics *in situ* in terms of the local habitat and of such genetic phenomena as are so superbly treated in parts four and five of this book. Should this fail, then the gods of theory and logic might be invoked.

I doubt if anything is gained by a definition of endemism that limits the term to distributional patterns of one area. So many of the phenomena of discontinuous distribution are so intimately linked with the causes of endemism that they are inseparable in many of their aspects.

After the able presentation by the author of the various aspects of what, in the past, has been termed the "science of area" and newly christened "areography," I think that we are justified in abandoning many of the ideas expressed in the papers reviewed by the author in this field. They are too irrelevant and on too precarious a scientific foundation. It is a subject in which generalizations are probably futile. This is especially true of many concepts of area and of dispersal and dispersal mechanisms. Distribution is intimately linked with organic processes subject to orderly physiological and physical law. History is the record of the sequence of very definite events in any given area. The vagaries of mass interpretations of area are too great for their safe application to the interaction of these rather complicated phenomena with the events of history.

In reading the discussion of "Evolution and Plant Geography" one cannot escape the feeling that the facts of the nature of species transcend immeasurably the importance of defining species. It would appear that the more one knows about speciation and species behavior the less significant is a definition that could include all types of species. The problems of speciation in the various parts of the plant kingdom are too diverse to permit of such a definition. In this part of the book, as well as in the part dealing with polyploidy, the facts of genetics and polyploidy are so ably treated that it seems almost presumptuous to criticize. Yet the science of plant geography would have been better served had the author summarized frequently in terms of methods of application and values to the plant geographer. For the moment, at least, the plant geographer seems to have been forgotten. To illustrate my point, in the general subject polyploidy, even under the heading "Geographic aspects of polyploidy," nowhere

does the author say in so many words that *the function of polyploidy in plant geography is to provide one of the methods of elaborating the genus and the species over the available habitats.* The geneticist would know that the author understood this rôle, but I doubt if the plant geographer not steeped in genetics would get the point.

In closing, one fact stands out in bold relief. In view of the significance of the 1922 paper of Turesson on the "Genotypical response of the plant species to the habitat" as a beacon light pointing to a common ground of understanding for the taxonomist, the geneticist and the plant geographer, and hence to the new taxonomy and the new plant geography, it is nothing short of amazing that this paper is not discussed in the text nor included in the excellent bibliography.

Regardless of possible differences in point of view, every plant geographer can hail this work as a notable and masterly achievement. It is that type of monument that a man builds to his career that will be enhanced by criticism rather than destroyed by it. The reception this book is bound to receive will serve to congratulate the author far beyond mere words.

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FIELD TRIPS OF THE CLUB

May 19-21, 1944. Branchville. The annual Branchville Nature Conference was held at the Haltere Hotel on Culvers Lake jointly with the Newark Museum Nature Club and the Summit Nature Club. The Conference was arranged by Mr. Wallace M. Husk as host and leader of a hike to Stokes Forest. Other leaders included Mr. Herbert Dole, Mr. David Fables, Prof. Julius Johnson, Miss Heyer and Mr. Harold Todd. This year's bird list recorded 86 species, two of them questionable. A plant list of 14 ferns, 4 fern allies, and 135 flowering plants (77 in flower at the time) excluding trees was compiled. Through the generosity of the Summit Club these lists have been mimeographed. A copy is filed with the field committee. At least 25 applications for the Conference had to be refused for lack of available accommodations. The committee must consider moving to a larger hotel or continuing to limit attendance to the accommodations available. We invite suggestions. Attendance 74.

May 21. Brooklyn Botanic Garden. "A beautiful day and the Garden was at its best. We saw plants of horticultural interest as Magnolia and Azalea and some of botanical interest as *Eucommia* and *Sinowilsonia.*" Leader, Charles Doney. Attendance 5.

May 27. Midvale, N. J. This was the season's first quest of fungi, and several species were reported by the leader, F. R. Lewis. Attendance 4.

May 27. Audubon Nature Center and Fairchild Connecticut Garden, Greenwich, Conn. This trip was ideal for nature study purposes since there is a great deal of accessible material concentrated in these areas. Lists of 41 birds and many attractive plants, native and introduced, were turned in to the field committee. Leaders, Henrietta Dotson and associates from the preserves. Attendance 13.

May 30. Woodlands, Westchester County, N. Y. "A multitude of very friendly inch worms came out to greet the Torrey group as it proceeded from Woodlands, up Ferncliff Road to the Bridle Path along the Sprain Ridge Brook, and across fields and woods to Ardsley. The group was composed of fifteen old, new, and prospective members and their friends, all of whom evidenced commendable interest in nature study, and did not particularly mind the somewhat inordinate interest in human nature displayed by the inch worms—"those obnoxious little green crawlers, who wiggle their way into everything but your affections." Some completely defoliated elms, oaks, linden, hickory and apple trees testified as to the taste and gastronomic prowess of the caterpillars, whose appetites now seemed to menace our clothing. Not that the natural food resources were altogether exhausted. The towering tulip trees, the spreading beeches, the various birches, maples, honey locust, sassafra, willows, poplars and mulberries had somehow escaped the ravages of the insect plague, and graced the landscape with the green splendor of their rich foliage. Because of a late spring, *Amorpha fruticosa*—the chief attraction of the trip—was not yet in bloom, though covered with promising buds. After a short stop at Ardsley for refreshments, some took the return train to New York, while others pushed on to Dobbs Ferry to visit Mr. F. C. Shipley's garden, which at this season generally looks like a huge bouquet of roses. Unfortunately these were not yet in bloom. In lieu of the lacking radiance of the roses, a blazing sunset on the Hudson provided a colorful ending to the ramblings across beautiful and historic Westchester County." Leaders, Alexandra Kalmykow and James Murphy. Attendance 15.

June 3. Far Rockaway. Here we were guests of the Department of Natural History of the Brooklyn Institute. Animal and plant life in a variety of habitats and showing a great degree of adaptation was pointed out. A thoroughly annotated list of a large number of species was prepared. Leader, Grace Petersen. Attendance 51.

June 4. Tohickon Creek, Bucks Co., Pa. The "highlights were *Salix longifolia, Prunus depressa, Polygonum Muhlenbergii* along the river shore; an exceptionally robust specimen of *Arisaema Dracontium* near the mouth of the Tohickon; 19 species of *Carex* all except one or two checked by Bayard Long and deposited in the herbarium of the Academy of Natural Sciences of

Philadelphia; *Cheilanthes lanosa, Camptosorus rhizophyllus, Woodsia obtusa* and *Cystopteris fragilis* all in close proximity along the rocks at Stover Park; observing of 9 of the 13 genera of the Urticaceae including the rather rare *Parietaria pennsylvanica;* finding of *Scutellaria nervosa;"* and *Ranunculus micranthus, Corydalis flavula, Festuca octoflora,* etc., on the cliff that drops a sheer 200-300 feet to the bed of the Tohickon. Leader, Louis Hand. Attendance 7.

June 10. Mt. Vernon, N. Y. The trip was rained out. Leader, Mrs. Mary Holtzoff.

June 11. Andover, N. J. Lichens, fungi, ferns, and higher plants were studied, and several limestone outcroppings were examined. Leader, G. G. Nearing. Attendance 4.

June 17-18. Forked River, N. J. Our week-end afforded us examples of all the typical pine barrens habitats except "the plains." Saturday afternoon was devoted to aquatics of the shallow pond and plants of the adjacent cedar swamp. In addition a considerable number of weeds were observed with comment about introduction, persistence, etc. Sunday was devoted to bogs and the dry upland. All of the more famous of the pine barrens species in flower at the time were observed. A list of 2 Bryophytes, 11 Pteridophytes and 244 Phanerogams was turned in to the field committee. Leader, H. K. Svenson. Attendance 14.

June 24. Montefiore Hospital, N. Y. City. "The place is interesting and my new flat (apartment) had some further attractions." Leader, Michael Levine. Attendance 8.

June 25. Berlin, N. J., offered a large station of *Rhododendron maximum* in full bloom in the interior of a woods with large specimens of *Betula lutea,* reminiscent of mountain tops some hundred miles northward. The actuality of the coastal plain was brought out by the not remote occurrence of *Itea virginica* and sour gum supporting mistletoe. A list of 13 Pteridophytes and 262 Phanerogams was prepared. Leader, Louis Hand. Attendance 3.

July 1. Ward's Point, Staten Island. Some 15-20 years ago a development was initiated here in what up to that time had been wilderness. The development failed and the revegetation has brought in new species. "The following seem worth recording: *Tradescantia virginiana* L. is now common here and has spread all over Tottenville in vacant lots and along roadsides. *Euphorbia Cyparissias* L. is well established in fields near the Point, *Tragopogon pratensis* L. in waste ground near an abandoned house. A scarcely expected find was a colony of *Allionia nyctaginea* Michx., native of the middle west and recorded as a rare adventive in eastern states, apparently well established here. A sizable patch

of ground in a wet spot off Hylan Boulevard was covered with *Mentha citrata* Ehrh. which seemed to be thriving. The prize find of the trip however was a couple plants of *Polanisia trachysperma* T. & G., another western plant. Norman Taylor's Flora of the Vicinity of New York mentions it only in a footnote as having been found as a waif in Connecticut." Gray's Manual concurs. Leader, Charles Ericson. Attendance 14.

July 2. Nepera Park, Yonkers, N. Y., provided nice weather, nice people, and a nice place for a walk including nature study in a general way, but particularly the plants. Leader, Eleanor Friend. Attendance 9.

July 9. Tuxedo, N. Y. Torrey trips contribute various things. This time an eminent botanist was present, anxious to secure Botrychium material for his research. We are pleased to report that he was most enthusiastic about what was found. *Botrychium simplex* var. *tenebrosum* is believed to be unreported previously from this part of the state. Leader, G. G. Nearing. Attendance 12.

July 15. West Orange, N. J. Mr. Dole's fern garden was in fine condition due to the daily watering and care. A number of new species had been added and, though a few had disappeared from the list of a year ago, there were 88 species, varieties, and fern allies to be seen. Leader, W. Herbert Dole. Attendance 21.

July 15. Lake Iosta, Haskell, N. J. Thirty-one varieties of fungi, including the leader's first discovery of *Amanita pantherina*, were reported. There was also a good showing of Russulas and of Boleti, the announced objective. Leader, F. R. Lewis. Attendance 2.

July 16. Van Cortlandt Park, Bronx, N. Y. A walk to observe native and introduced plants under park conditions. Leader, Joseph Monachino. Attendance 10.

July 23. Arden, N. Y. A re-examination of a portion of the Appalachian Trail in this vicinity was made. The earlier survey appears to have been thorough, since no new species were reported. Leaders, G. G. Nearing and James Murphy. Attendance 10.

July 30. South Mountain Reservation, Essex County, N. J. Plants of the trap rock exposures, slopes, and valleys were observed between South Orange and Millburn. A fair number of fungi were seen by those interested. Leader, William Rissanen. Attendance 15.

August 5. Haskell, N. J. The object was to continue the search for Boleti in this vicinity, but the protracted dry spell reduced the report to "everything

now dried up, but did find a group of four *Laccaria amethystina*." Leader, F. R. Lewis. Attendance 2. Temperature 95 in the shade.

August 6. Southfields, N. Y. This trip was announced for April 16, but rained out. It was hot and dry enough on this date! Nevertheless, 82 lichens species were reported, including *Cladonia multiformis*, which the leader had found only once before in the region of New York City. Leader, G. G. Nearing. Attendance 4.

August 12. The New York Botanical Garden. The leader, B. O. Dodge, and the one known participant failed to connect. Attendance might have been 2.

August 13. Tuxedo-Sloatsburg, N. Y. The walk to Daters Mt. Lost Cabin was cut in half because of the heat. The fungi were reduced to nil because of the drought, except for a colony of *Clitocybe illudens* found on a log near the end of the trip. *Botrychium simplex* and *B. lanceolatum* were unusual discoveries. Leader, F. R. Lewis. Attendance 4.

August 20. Sloatsburg, N. Y. The Stony Brook Trail was worked again for lichens and fungi. Leader, G. G. Nearing. Attendance 13.

August 27. Schunemunk Mt., N. Y. No official report received. Rumor is, four well-satisfied participants. Leader, Alexander V. Tolstoouhov.

September 3. Haskell, N. J. Lichens and early fall flowering plants were observed in this region, but the report mentions no fungi. Leader, G. G. Nearing. Attendance 4.

September 10. Hopewell, N. J. The scheduled leader failed to appear, but good botanists were at hand, and so an interesting trip was reported nevertheless. The protracted drought had reduced the profusion of vegetation, as was to be expected. Attendance 9.

September 17. Richmond Valley, Staten Island. Because of illness, Mr. W. T. Davis arranged for a substitute leader on this trip to study hybrid oaks. A considerable variety of oaks dominates this woodland, including a number of hybrids, some with parentage appearing to be blackjack and willow oak, others with one parent or both not obvious. The autumn season was apparent by the coarse flowering plants making up the conspicuous part of the roadside and field flora. Those reported as worthy of mention include: *Solidago odora* Ait., *Eupatorium hyssopifolium* L., and *Tanacetum vulgare* L. Plants reminding one of the pine barrens included the shrubby willow, *Salix tristis* Ait., and *Strophostyles helvola* (L.) Britton. There was a conspicuous roadside display of *Ipomea pandurata* (L.) Meyer with large, white, funnel-shaped corollas. Leader, Charles Ericson. Attendance 12.

September 17. Englewood Cliffs, N. J. The drought continued and our trip for fungi brought in a report that "the woods were practically bare of fungi with the exception of *Mycena galericulata* and *Stropharia semiglobata* which are always present." Leader, E. D. Hallock.

September 23. Richmond, Staten Island. The most impressive part of this trip was the hurricane damage of September 14, destroying trees, obstructing trails, and flooding some areas. All of the woody species promised were found with the exception of *Broussonetia papyrifera*. The decreasing stand of *Evonymus* was noted. Leader, Grace Petersen. Attendance 9.

September 24. Pine Barrens, N. J. The autumn excursion included the following places: Pleasant Mills, where Pickering's morning glory was a plant of particular interest, and where sand gentians and blazing star, together with typical pine barrens species of aster and goldenrod were also conspicuous. At Herman a walk near the mouth of Bull Creek turned up a nice stand of *Eupatorium resinosum* and further species of goldenrod and aster. Along the shore of Mullica River, *Smilax Walteri, S. laurifolia, Ilex verticillata, I. laevigata,* and *Viburnum nudum* were found. At Batsto Pond *Eriocaulon Parkeri, Isoetes Braunii, Lycopus sessilifolius* and *Spiranthes cernua* were conspicuous. At Pleasant Mills a delightful bit of savannah was found which "gives one that feeling of strangeness and excitement which characteristic pine barrens locale affords." Leader, Louis Hand. Attendance 5.

September 24. Mineola, Long Island. Mr. Joseph Rispaud substituted for Mr. Robert Hagelstein in the search for slime molds. Attendance was not reported.

September 30. McClean Woods, Bronx, N. Y., afforded a study of asters, goldenrod, autumn ferns, and wayside plants. Leader, Mrs. Mary Holtzoff. Attendance 6.

October 1. Richmond, Staten Island. The old fields and salt marsh were explored. In the absence of a report it is assumed that nothing was added to the records of previous trips. Leader, Hester Rusk.

October 8. Old Mill Road, Bronx, N. Y. There was a plentiful display of asters, goldenrods, and other autumn plants to be expected in this region. *Rhus Vernix* was reported as abundant. Leader, Farida Wiley. Attendance 15.

October 14. Barrett Park Zoo, Staten Island. Leader, Miss Condon. No report received.

October 15. Brooklyn Botanic Garden. The trip included a study of conifers, a report on the chestnut breeding work, and tea. Leader, Arthur H. Graves. Attendance 4.

October 15. Southfields, N. Y. A list was made of 24 mushrooms, and lichens and flowering plants were also observed. Leader, F. R. Lewis. Attendance 5.

October 22. Palisades and Alpine, N. J. Leader, James Murphy. Attendance 11. No detailed report.

October 29. Palisades Interstate Park. Mr. Joseph Bartha kindly volunteered to guide the Raymond H. Torrey Memorial trip to Long Mountain. No report of the attendance.

November 5. Bound Brook to North Plainfield, N. J. This walk offered the various habitats which had been announced. No list was made, as the species found were those to be expected, except that we were disappointed not to find gentians. Leader, John A. Small. Attendance 27.

PROCEEDINGS OF THE CLUB

Minutes of the Meeting of October 18, 1944

The meeting was called to order at 3:30 p.m. by President Levine in the Members' Room of The New York Botanical Garden. There were twenty-three members and guests of the Club present. The minutes of the preceding meeting were approved as read. Dr. Karling read the tentative ballot which had been prepared by the Nominating Committee for 1945. The President appointed a committee consisting of Drs. Karling, Graves, and Matzke as chairman, to draw up a memorial minute on Dr. H. M. Denslow.

The scientific program consisted of an interesting presentation by Prof. J. S. Karling on "Unusual Chytridiaceous Fungi from Brazil." After considerable discussion of chitin-destroying fungi, and of the evolutionary relationships within the whole group of the fungi, the meeting adjourned at 4:35 p.m. to partake of the refreshments generously provided by The New York Botanical Garden.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of November 15, 1944

The meeting was called to order at 3:30 p.m. by President Levine in the Members' Room of The New York Botanical Garden, with twenty-seven members and guests of the Club in attendance. The minutes of the preceding meeting were approved as read. The following memorial minute on Dr. H. M.

Denslow was read to the Club by the Corresponding Secretary. The Club voted that a copy of this minute be sent to the family of the late Dr. Denslow.

Whereas: Dr. Herbert McKenzie Denslow, a charter member of the Torrey Botanical Club, President of the Club during the years 1928-1929, and Editor of its *Bulletin* during the year 1924, died on September 7, 1944.

Be it resolved: that we, the members of the Torrey Botanical Club, express our sense of loss at his passing. His was a long and useful life, as pastor, teacher, and botanist. Born on August 20, 1852, he early became interested in systematic botany through his uncle, William Wallace Denslow (1826-1868). Both were charter members of the Torrey Botanical Club, in 1867. Although an Episcopal minister and later a professor of pastoral thology in General Theological Seminary, he always retained his enthusiasm for botanical collecting, being especially interested in the native orchids; a considerable list of published papers on this subject bears witness to his industry.

Resolved further: that a copy of these resolutions be sent to the members of his immediate family.

(Signed) Arthur H. Graves
John S. Karling
November 10, 1944 Edwin B. Matzke

The scientific program consisted of an inspiring talk by Prof. R. H. Goodwin of Connecticut College on "Some Effects of Light upon the Growth and Differentiation of the Oat Seedling." The speaker's abstract follows:

The apical meristem of the germinating oat seedling is protected by the sheath-like coleoptile as it is pushed to the soil surface by the elongation of the first internode—that portion of the stem between the scutellar and the coleoptilar nodes. Elongation of the internode is inhibited by light.

Two distinct phases in the inhibition of elongation can be distinguished. The first is characterized by high sensitivity to radiant energy and is due to the suppression of cell division. The extent to which cell division is inhibited depends directly upon the amount of radiant energy received by the plant. The second phase of the inhibition is characterized by a much lower sensitivity to radiant energy and is due to a reduction of cell elongation.

A study has been made of the development of vascular elements in the internode. Annular, spiral, and pitted elements are successively differentiated, but the presence of transitional types is emphasized. The first center of development of pitted elements arises at the scutellar node and a wave of differentiation surges upward from this point through the internode. A second center occurs later at the coleoptilar node, but the last portion to show pitted elements is in the growing region just below the coleoptilar node.

The rate of formation of spiral and particularly of pitted elements is greatly increased after exposures to visible light, pronounced effects being observed as early as twelve hours following weak irradiations. The close correlation between the light inhibition of elongation of the internode and the formation of pitted xylary elements which are incapable of growth in length, is significant.

The stimulus producing the inhibition of the internode may be received either by the tip of the seedling—the coleoptile or the true leaves contained therein, or by the internode itself. The internode exhibits a wide range of spectral sensitivity, being affected by wave lengths ranging from the ultra violet to the infra red. In the completely etiolated seedling carotinoids are abundantly present in the true leaves, but in other portions of the plant pigments are present only in small amounts. True chlorophyll is apparently absent. But

Frank (unpublished) has demonstrated the presence of a pigment with an absorption spectrum somewhat similar to chlorophyll, which is responsible for chlorophyll formation. It is not impossible that this pigment may also be involved in the inhibition of the internode, since it absorbs strongly in the red, a property not shared with the carotinoids.

After considerable discussion of Dr. Goodwin's interesting presentation, the meeting was adjourned at 4:35 p.m., but continued informally, with enjoyment of the refreshments generously provided by The New York Botanical Garden.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Meeting of December 5, 1944

The meeting was called to order at 8:15 p.m. by President Levine in Room 710 of Schermerhorn Extension, Columbia University. Forty-nine members and guests were present. The minutes of the preceding meeting were approved as read.

The scientific program of the meeting was presented by Prof. John W. Shive. Professor Shive gave a most interesting talk on "The Iron Manganese Relation in Plants," illustrating it with lantern slides.

After considerable discussion of the paper, the meeting was adjourned at 9:20 p.m.

Respectfully submitted,

Honor M. Hollinghurst
Recording Secretary

Minutes of the Meeting of December 20, 1944

The meeting of the Torrey Botanical Club at The New York Botanical Garden was called to order at 3:30 p.m. by President Levine, with twenty-five members and guests in attendance. The minutes of the preceding meeting were accepted as read. The President appointed a committee consisting of Drs. Karling and Matzke to count the ballots for the election of officers for 1945. An auditing committee consisting of Professor Trelease, Chairman, Mr. Montagne, and Dr. Seaver was appointed by Dr. Levine to audit the books for the year 1944.

The scientific program consisted of an interesting talk by Prof. Ray F. Dawson of Princeton University on "Some Aspects of Alkaloid Production in *Cinchona*." The speaker's abstract follows:

A population of Philippine *Cinchona "Ledgeriana"* was found to be of hybrid origin. Plants bearing the morphological characteristics to be expected of haploids, diploids, tetraploids, and octoploids have been obtained from this population. Of these, the "tetraploid" is the most vigorous in growth.

Physiological experiments have shown that at least a substantial fraction of the total alkaloid output in the plant is localized in the root system. Increasing the supply of nitrogen to the root system may result in increases in the relative alkaloid content even though growth be no longer affected.

A discussion of Professor Dawson's paper was continued informally after the meeting adjourned at 4:40 p.m. while members enjoyed the refreshments generously provided by the ladies of The New York Botanical Garden.

Respectfully submitted,

Edwin B. Matzke
Corresponding Secretary

Minutes of the Annual Meeting, January 9, 1945

The annual dinner meeting was held at the Men's Faculty Club, Columbia University. Eighty-seven members and guests were present. The meeting was called to order at 8:20 p.m. by President Levine. The minutes of the preceding meeting were approved as read. Annual reports were read by the Corresponding Secretary and the Treasurer.

The names of the following newly elected officers of the Club were read by the Corresponding Secretary:

President:	Fred J. Seaver	
First Vice-President:	John A. Small	
Second Vice-President:	A. E. Hitchcock	
Corresponding Secretary:	Jennie L. S. Simpson	
Recording Secretary:	Frances E. Wynne	
Treasurer:	E. H. Fulling	
Editor:	Harold W. Rickett	
Bibliographer:	Lazella Schwarten	
Business Manager:	Anne M. Hanson	
Members of the Council:	John M. Arthur	Edwin B. Matzke
	Ralph M. Cheney	Sam F. Trelease

Delegate to the Council of the New York Academy of Sciences: Bernard O. Dodge

Representative on the Board of Managers of The New York Botanical Garden: Henry A. Gleason

Representatives on the Council of the American Association for the Advancement of Science: Albert F. Blakeslee, P. W. Zimmerman

Dr. Levine introduced Dr. Seaver, the new President, who spoke a few words of greeting to the Club.

The scientific program of the evening was presented by Mr. P. J. McKenna who gave a very interesting talk on "The Relation of Botany to Horticulture." Mr. McKenna concluded with motion pictures in color of trees, shrubs, and herbaceous plants.

The meeting was adjourned at 9:30 p.m.

Respectfully submitted,

Honor M. Hollinghurst
Recording Secretary

Minutes of the Meeting of January 17, 1945

After tea, served by the faculty of the Biology Department of Fordham University in Larkin Hall, the meeting of the Torrey Botanical Club was called to order at 4:05 p.m. by President Seaver, with thirty-three members and guests present. The minutes of the preceding meeting were accepted as read. Dr. Seaver reported two vacancies on the Council caused by the election of members of the Council to other offices. Dr. Fulling nominated Drs. George S. Avery and P. W. Zimmerman to fill these vacancies. The motion was seconded and accepted by the Club.

The scientific program consisted of an interesting paper by Dr. Eleanor R. Witkus, entitled "Cytology of Tapetal Cells in *Spinacia*." The speaker's abstract follows:

Some of the divisions occurring in the tapetal cells of spinach are similar to those described by previous workers in other plants. There is, however, one type of division which is new to tapetal cell literature. This new type is called endomitosis. This process was first discovered by Geitler (1939) in insect material. During this type of division there is a reproduction of chromosomes, but no spindle is formed, and there is no true anaphase movement of the chromosomes. Throughout the whole process the nuclear membrane remains intact. The resulting nucleus has twice the number of chromosomes that were present in the original nucleus. Geitler divided endomitosis into four stages: endoprophase, endometaphase, endoanaphase, and endotelophase. Endoprophase is similar to the prophase of normal mitosis. The chromosomes contract until a maximum degree of condensation is reached. The condition of maximum contraction is referred to as endometaphase. There is no spindle and the chromosomes do not congress upon an equatorial plate. After attaining their maximum contraction the spindled attachment regions of the chromosomes divide and the chromosomes separate slightly. This stage is called endoanaphase, but there is no true anaphase movement of the chromosomes. After the spindle attachment regions divide the chromosomes begin their reversion to the resting stage. This reversion is called endotelophase.

In spinach the tapetal cells undergo two divisions during the meiotic process. Both these divisions take place during the zygotene synizesis stage. The first division may be one of three types. Normal mitosis may take place, but no cell plate is formed and a binucleate tetraploid cell results. In the second type, the cell may undergo an abnormal mitosis due to the presence of sticky chromosomal bridges. As a result a uninucleate tetraploid cell is formed with a dumb-bell shaped nucleus. Or the cell may undergo a third type of division, endomitosis, forming a tetraploid uninucleate cell.

The resulting cells may remain in the resting condition or may undergo a second division. The second division is in all cases endomitotic and like the first takes place during zygotene synizesis. The cell resulting from this second division is an octoploid cell, either binucleate, or uninucleate in which case the nucleus is dumb-bell shaped.

These endomitotic cycles, like those described by Geitler, consist of endoprophase, endometaphase, endoanaphase, and endotelophase. Throughout the whole process the nuclear membrane remains intact, there is no spindle and consequently no anaphase separation or polar movement of the chromosomes.

It seems probable that endomitosis may not be peculiar to the tapetal cells of *Spinacia*, but may have a wider application and may explain many of the cytological phenomena occurring in the tapetal cells of other plants, which up to now have been rather obscure.

The meeting was adjourned at 4:45 p.m. in order that the members might carry on an informal discussion and look at the excellent demonstrations prepared.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

NEWS NOTES

The following item came just too late to be included in the December number:

The California Academy of Sciences has just issued the Alice Eastwood Semi-Centennial Publications in its Fourth Series of Proceedings, honoring the 85 year-old botanist's fifty year term as a member of the Academy staff where she is active head of the botany department. Of interest to botanists and flower lovers, the 14 pamphlets include such titles as: "A Revision of the Genus Fuchsia," by Philip A. Munz, professor of botany at Pomona College; "Relations of the Temperate Flora of North and South America," by Prof. Douglas Campbell; "Water and Plant Anatomy," by emeritus Prof. George Pierce of Stanford. The series of publications is available to the public at the California Academy of Sciences in Golden Gate Park, San Francisco.

Through an oversight, the name of Prof. H. H. Whetzel of Cornell University was omitted from the list published in the last number of Torreya, of botanists who died last year. His death occurred on November 30, 1944.

Mr. William T. Davis, well known to many members of the Torrey Club for his work in entomology, and on the local flora, as a leader of numerous nature walks on Staten Island, and for his activity in the Staten Island Historical Society, died on January 22, 1945.

THE TORREY BOTANICAL CLUB

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OTHER PUBLICATIONS

OF THE

TORREY BOTANICAL CLUB

(1) BULLETIN

A journal devoted to general botany, established in 1870 and published bi-monthly at present. Vol. 71, published in 1944, contained 680 pages and 3 plates. Price $6.00 per annum. For Europe, $6.25.

In addition to papers giving the results of research, each issue contains the INDEX TO AMERICAN BOTANICAL LITERATURE—a very comprehensive bibliography of current publications in American botany. Many workers find this an extremely valuable feature of the BULLETIN.

Of former volumes, 24-71 can be supplied separately at $6.00 each; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Single copies ($1.00) will be furnished only when not breaking complete volumes.

(2) MEMOIRS

THE MEMOIRS, established 1889, are published at irregular intervals. Volumes 1-19 are now completed. Volume 17, containing Proceedings of the Semi-Centennial Anniversary of the Club, 490 pages, was issued in 1918, price $5.00.

Volume 19, no. 1, 92 pages, 1937, price $1.50. Volume 19, no. 2, 177 pages, 1938, price $2.00. Volume 19, no. 3, 76 pages, 1940, price $1.25. Volume 19, no. 4, 57 pages, 1941, price $1.00. Volume 19 complete, price $5.00.

Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

Reprinted monthly on cards, and furnished to subscribers at three cents a card.

Correspondence relating to the above publications should be addressed to

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New York 27, N. Y.

Volume 45 June 1945 Number 2

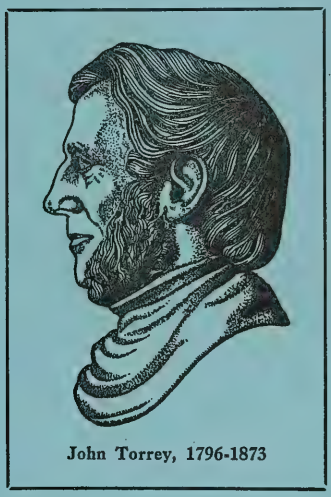
TORREYA

EDITED FOR

THE TORREY BOTANICAL CLUB

BY

HAROLD H. CLUM



John Torrey, 1796-1873

CONTENTS

Island Beach ..... JOHN A. SMALL 33

A Leafy Form of Hypericum gentianoides ..... H. K. SVENSON 36

A List of Fleshy Fungi of Fishers Island, N. Y. ..... CHARLES C. HANMER 38

A Contribution to our Knowledge of the Wild and Cultivated Flora of Massachusetts ..... HAROLD N. MOLDENKE 41

Book Reviews

Travelers All ..... ALMA L. MOLDENKE 53

The Arctic Prairies ..... HUGH M. RAUP 53

Field Trips of the Club 56

Proceedings of the Club 57

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All persons interested in botany are invited to join the Club. There are four classes of membership: *Annual,* at $5.00 a year; *Associate,* at $2.00 a year; *Sustaining,* at $15.00 a year; and *Life,* at $100.00. The privileges of all except *Associate* members are to attend all meetings of the Club, to take part in its business, and to receive all current publications, except the *Memoirs* which are sold to members at cost. *Associate* members have the privilege of attending all meetings and field trips. They also receive the *Schedule of Field Trips* and the *Bulletin* of the New York Academy of Sciences. Applications for membership should be addressed to the Treasurer.

TORREYA

Torreya was established in 1901 as a monthly publication of the **Torrey Botanical Club** for shorter papers and interesting notes on the local flora range of the Club. It also contains the proceedings of the Club, reports of field trips, and some book reviews and news notes. The current volume will be issued in four numbers.

The editor invites contributions for future numbers of Torreya. These should be typed with double spacing on one side of standard paper. Illustrations should be mounted on stiff cardboard, with the desired reductions plainly indicated, and so designed as to fill the full width of the page (4⅝ inches) and any portion of the height (7⅛ inches). Legends for illustrations should be typed and included with the manuscript (*not* affixed to the figures).

The subscription price of Torreya in the United States and Canada is $1.00 a year, for subscribers elsewhere, 25c extra; single copies, 40c. Of the annual membership dues of the **Torrey Botanical Club**, $0.50 is for a year's subscription to Torreya.

Claims for missing numbers should be made within sixty days from the date of mailing.

Subscriptions and requests for back numbers should be addressed to the Business Manager, Miss Anne M. Hanson, Department of Botany, Columbia University, New York 27, N. Y.

Manuscripts for publication, books for review, reports of field trips, and news items should be addressed to:

Harold H. Clum
Hunter College, 695 Park Avenue
New York 21, N. Y.

TORREYA

VOL. 45 JUNE 1945 NO. 2

Island Beach*

JOHN A. SMALL

Some comments may be of interest to readers in view of the Resolution about Island Beach appearing in this issue. Located in Ocean County, New Jersey, within the so-called Torrey Range, Island Beach is a sand bar nine miles long. It is less than half a mile across except for two places where its width approaches three quarters of a mile. It is separated two and one half to four and one half miles from the mainland by Barnegat Bay. At the present time it is not an island but a peninsula joining the mainland at Point Pleasant, several miles to the north. The part of the peninsula above Island Beach has been developed to varying degrees as summer resort areas, the adjacent one being Seaside Park. Barnegat inlet forms the southern boundary. One very old map shows an inlet just north of Island Beach. This has been closed certainly well over a century.

Politically, Island Beach is a borough, though almost unpopulated. Originally it was a part of three townships, though always as a small, disconnected remnant across the bay. This made fire protection and policing almost nonexistent. Vandalism and the fire hazard discouraged owners and retarded real estate development. When the Barnegat Bay and Beach Company acquired almost exclusive ownership some years ago they petitioned the Legislature to make it a borough for its own protection. This was done. The area has since been held as a real estate investment. The only means of access, other than boat, is from Seaside Park via a service road which extended half the length of the Borough until completed by the army as a defense measure.

With the successful development of a state park program, the development of such a park at the seashore was an obvious suggestion. The Division of Forests and Parks of the State Department of Conservation and Development was interested. A recommendation for such use of the land was made later by the State Planning Board.

In the spring of 1940 legislation was introduced to disincorporate the Borough and return the land to the three townships. Faced with the possibility of having its property without adequate protection, the Barnegat Bay and Beach Company advertised that should the legislation be enacted the

* See the resolution, adopted by the Club, March 21, 1945, on p. 60, and letters in reply, pp. 62, 63.

TORREYA for June (Vol. 45, 33-64) was issued June 29, 1945.

area would be laid out in "trailer lots" and placed on the market. The legislation was not enacted but the eyes of people with diverse interests in Island Beach had been opened to the possibilities, and the possibilities were not pleasant. Regaining a clear title to the area after its subdivision and sale to thousands of small owners would be neither easy nor cheap.

In November of 1940 a meeting was called by Governor Moore. Representatives of State departments, local governments, civic groups, societies, and individuals were invited to discuss the possible future of the area. A member of the National Park Service gave general information on the establishment and administration of reservations under their jurisdiction. Many possibilities were presented. It was decided to appoint a committee to approach members of the legislature for their views and for information on the probability of purchase and development of the area by the State. The group was reassembled on August 30, 1941 and the committee reported that responsible members of the legislature saw no prospects of the State being able to finance a proposition of this size. There was general agreement among the many groups represented that the greatest hope of saving this area from commercialization lay in getting it under the administration of the National Park Service.

Came the war. This exposed and almost uninhabited area was immediately placed under constant surveillance. It has remained under army control and more or less closed to civilians. In 1942 when the army's projection of the roadway to the end of the bar was decided upon, the Chief of Engineers was advised of the unique and important natural history embodied in the area.

During the past two years there has been a considerable reorganization of the state government in New Jersey. In the course of this a Department of Economic Development has been set up. One of its acts has been a survey of projects of public works that might be undertaken should it become desirable for the State to supplement business and industry in the maintenance of employment levels. Among the recommendations to the Governor was that of acquiring Island Beach for development as a state park and public playground. One of our members, Dr. George H. Shull, addressed an open letter to the Governor opposing this recommendation in view of the importance of maintaining the status quo in this last example of such an area. There has been some exchange of ideas on the philosophy of public beach and playground to be used by a great many as compared with the preservation of a natural area to be used by relatively few. No one has objected to the acquisition and development of some equally or more desirable site for public use but there is no other area suitable for preservation as a natural seashore area in New Jersey, and quite possibly none the equal of Island Beach north of Cape Hatteras.

Dr. Shull, the writer, and others have been taking advanced classes to Island Beach for study over a period of years. Many other interested groups have been conducted over the area. The Torrey Botanical Club selected this and the pine barrens for its 75th Anniversary foray as the two most unique and important areas within its range. If we should preserve representative pieces of natural vegetation as museum pieces for posterity, here is what Island Beach has to offer: 1, Beach vegetation for nine miles on the open ocean and an equal distance on the bay; 2, Dune vegetation in all stages of its dynamics; 3, Dune thickets; 4, Dune hollows; 5, Fresh marsh; 6, Salt marsh; 7, Acres of Hudsonia heath; 8, Coastal plain forest; 9, Southern white cedar swamp; and 10, Bog.

The last three of these plant communities are of particular interest in their resemblance, on a miniature scale, to the similar communities constituting the well known pine barrens of inland southern New Jersey. May it be that we are seeing here the floristics that once occurred on that area?

In view of the turbulent history of Island Beach, its present unified ownership, and the relatively moderate disturbance that has thus far occurred, it seems unlikely that there will be a more opportune and desirable time of transferring it to the status of a natural history preserve, if it is deemed worthy of preservation. The National Park Service remains interested and seems the most desirable administrative agency. The initiative must be taken by the State, an enabling act must be passed by the Congress, and, perhaps most difficult of all, the land must be purchased.

New Jersey College for Women
Rutgers University
New Brunswick, New Jersey

A Leafy Form of Hypericum gentianoides

H. K. Svenson

One of the most abundant plants in sterile rocky or sandy places from Maine to Texas, is the little branched annual known as "orange grass" or "pine weed." The leaves are reduced to minute scales usually only 1 mm. long, though occasionally on elongate shoots they may reach 2 or 3 mm. It was, accordingly, a great surprise to find among the hundreds of plants which grew on the sandy borders of the Merrick Reservoir (Nassau County, Long Island) a single plant with well-developed leafy shoots, illustrated in the accompanying photograph. The flowering stalks of the little plant are only 5 cm. high, about the same size as the leafy shoots which radiated out on the sand to form a rosette. The lanceolate spiny-tipped leaves are mostly 4-5 mm. long, appressed to the stem, and considerably broader than in *Hypericum Drummondii* of the Mississippi Valley, which is sometimes united with *Hypericum gentianoides* to form the genus *Sarothra*. This was an old genus established by Linnaeus, with the help of his student Chenon, when the affinities of the plant were obscure and *Hypericum gentianoides* was supposed to be a member of the gentian family. It does resemble *Bartonia,* and by Plukenet and other early writers it had been considered as a kind of "Centaurium," a name later taken up by Persoon for *Bartonia*. Clayton noted that the plant was called "ground pine" in Virginia, but that name is now commonly applied to species of *Lycopodium*. Mr. Weatherby had the kindness to look at the specimen which is illustrated here and he also pronounced it to be *Hypericum gentianoides*. I have known the "orange grass" since I was a small child, but have never seen any other specimen of a leafy plant. The specimen (*Svenson* no. *11,658,* Sept. 15, 1941) is at the Brooklyn Botanic Garden.

Brooklyn Botanic Garden
Brooklyn, New York

HYPERICUM GENTIANOIDES
(Photographed by the Brooklyn Botanic Garden)

A List of Fleshy Fungi of Fishers Island, N. Y.

Charles C. Hanmer

The fungi listed below were collected by the writer about forty years ago, and in 1929 the entire collection was presented to the Brooklyn Botanic Garden, Brooklyn, N. Y. Nearly all of the species listed were critically named by several mycologists, many by the late Prof. Charles H. Peck, Prof. George F. Atkinson, Prof. E. A. Burt, Charles McIlvain, Charles G. Lloyd, and several others

During the past two years the writer has been over the old localities, where there was fine collecting years ago, but Fishers Island has changed in many respects. The wooded areas, known as "The Brick Yard Woods," where most of the plants common to such a habitat were collected, were later used as a sheep pasture. This completely ruined the place for collecting purposes. Then came the hurricane of 1938, completing the devastation, so that it will be generations before any such wealth of fungus growth will be found there again. The open fields still have fair amounts of the species which usually are found there. *Agaricus campestris* and many of the Gasteromycetes are still common.

My collection of the genus *Russula* is very incomplete, but aside from that genus, I believe the collection to be fairly representative of the Fishers Island fleshy fungi.

Ascomycetes

Geoglossum farlowi Cke. Aug. 3, 1902, *187;* Sept. 7, 1902, *589;* Sept. 6, 1903, *1550.*

Geoglossum hirsutum Pers. Aug. 24, 1902, *425.*

Geoglossum peckianum Cke. July 13, 1903, *1348.*

Daldinia concentrica (Bolt.) Ces. & De Not. Aug. 3, 1902, *199, 200-202;* Aug. 24, 1902, *423, 424.*

Basidiomycetes

tremellaceae

Tremella intumescens Eng. Bot. June 22, 1903, *1303.*

Tremelladendron candidum (Schw.) Atk. Aug. 3, 1902, *192-194.*

Tremelladendron merismatoides (Schw.) Burt (*Clavaria merismatoides* Schw.) Aug. 15, 1903, *1478;* Sept. 2, 1905, *2100.*

thelephoraceae

Thelephora multipartita Schw. Aug. 3, 1902, *198;* Aug. 2, 1903, *1420;* Sept. 10, 1905, *2117.*

Thelephora palmata Fr. Aug. 3, 1902, *196.*

CLAVARIACEAE

Clavaria cinerea Bull. Aug. 3, 1902, *197;* Aug. 15, 1903, *1476, 1477.*
Clavaria corraloides Linn. June 22, 1903, *1307, 1308.*
Clavaria fusiformis Sow. Aug. 3, 1902, *190, 191;* Aug. 24, 1902, *426;* Aug. 15, 1903, *1464.*

HYDNACEAE

Hydnum concrescens Pers. Aug. 27, 1905, *2094.*
Hydnum scrobiculatum Fr. Aug. 3, 1902, *133;* Aug. 27, 1905, *2095.*
Hydnum zonatum Batsch. Aug. 15, 1903, *1470.*

POLYPORACEAE

Boletus affinis Pk. Aug. 3, 1902, *145, 149, 150, 164.*
Boletus affinis var. maculosus Pk. Aug. 3, 1902, *146, 148.*
Boletus castaneus Bull. Aug. 3, 1902, *142, 143, 163.*
Boletus felleus Bull. Aug. 2, 1902, *132;* Aug. 2, 1903, *1318.*
Boletus Frostii Russell Aug. 3, 1902, *135-138;* Aug. 2, 1903, *1428, 1429.*
Boletus luridus Schaeff. Aug. 14, 1904, *1878, 1879.*
Boletus pallidus Frost Aug. 2, 1903, *1427;* Aug. 14, 1910, *2532.*
Boletus parasiticus Bull. on *Scleroderma vulgare* Pers. Aug. 17, 1902, *352, 353.*
Boletus Peckii Frost Aug. 3, 1902, *144.*
Boletus purpureus Fr. Aug. 14, 1904, *1875.*
Boletus Russelli Frost Aug. 14, 1910, *2521.*
Boletus speciosus Frost Aug. 2, 1903, *1422.*
Boletus subglabripes Pk. Aug. 14, 1910, *2522.*
Boletus subtomentosus Linn. Aug. 19, 1902, *362.*
Boletus vermiculosus Pk. July 13, 1902, *91, 134, 139, 140;* Aug. 14, 1904, *1873.*
Boletus vericulosus var. Spraguei Pk. Aug. 3, 1902, *141.*
Boletinus porosus (Berk.) Pk. Aug. 2, 1903, *1423.*
Polyporus Berkeleyi Fr. Aug. 2, 1903, *1425.*
Polyporus betulinus (Bull.) Fr. 1942. Not collected.
Polyporus cinnabarinus Schw. 1941. Not collected.
Polyporus elegans Fr. Aug. 3, 1902, *161.*
Polyporus Spraguei B&C. Sept. 4, 1905, *2289.*
Polystictus perennis Fr. Aug. 15, 1903, *1469.*
Daedalea Confragosa Klotzchii Pk. (*Lenzites Klotzchii* Berk.) Aug. 24, 1902, *428;* Sept. 6, 1903, *1559.*
Daedalea confragosa var. rubescens Pk. (*Trametes rubescens* A. & S.) Aug. 3, 1902, *173, 174.*
Cyclomyces Greenii Kunz. & Fr. Aug. 24, 1902, *421.*
Merulius lacrymans Fr. Oct. 6, 1944. Not collected. Doing great damage to a wooden cellar floor.

AGARICACEAE

Agaricus arvensis var. purpurescens Cke. Sept. 14, 1905, *2129.*
Agaricus campestris var. exannulatus Cke. Sept. 6, 1903, *1539.*
Amanita muscaria Linn. Sept. 10, 1905, *2115.*
Amanita phalloides Fr. Aug. 2, 1903, *1426.*
Amanitopsis strangulata (Fr.) Roze June 22, 1903, *1306.*
Cantharellus cibarius var. simplex Fr. Aug. 3, 1902, *152.*
Clitocybe adirondakensis Pk. Aug. 14, 1904, *1871.*

Clitocybe laccata Scop. July 13, 1902, *93;* Aug. 3, 1902, *166.*
Clitocybe prunulus Scop. Sept. 6, 1903, *1542.*
Collybia acervata Fr. Aug. 3, 1902, *171.*
Collybia lacera Lasch. Sept. 10, 1905, *2121.*
Collybia platyphylla Fr. Aug. 3, 1902, *167.*
Collybia strictipes Pk. Aug. 3, 1902, *168, 169, 170.*
Cortinarius cylindripes Kauff. Aug. 3, 1902, *165.*
Cortinarius cinnamomeus var. semisanguineus Fr. Sept. 10, 1905, *2118.*
Entoloma cuspidatum Pk. Sept. 10, 1905, *2120.*
Flammula spumosa Fr. Aug. 14, 1904, *1872.*
Galera tenera Schaeff. Aug. 14, 1904, *1867.*
Hygrophorus ceraceus Fr. Sept. 7, 1902, *594.*
Hygrophorus chlorophanus Fr. Sept. 10, 1905, *2122.*
Hygrophorus conicus Fr. Sept. 6, 1903, *1543.*
Hygrophorus lacteus Fr. Sept. 7, 1902, *592.*
Hygrophorus marginatus Pk. Aug. 3, 1902, *175-178;* Sept. 7, 1902, *593.*
Hygrophorus nitidus B. & Reav. Sept. 7, 1902, *591;* June 22, 1903, *1305.*
Hygrophorus virgineus Fr. Sept. 7, 1902, *595, 599, 601.*
Hypholoma appendiculatum Bull. 1941. Not collected.
Lactarius aquifluus Pk. Aug. 15, 1903, *1469.*
Lactarius helva Fr. Aug. 14, 1910, *2526.*
Lactarius involutus Soppit Aug. 15, 1903, *1479, 1480.*
Lactarius lignyotus Fr. Aug. 3, 1902, *154.*
Lactarius luteolus Pk. Aug. 3, 1902, *186.*
Lactarius piperatus Fr. Aug. 3, 1902, *155, 157, 184.*
Lactarius serifluus Fr. Aug. 3, 1902, *183.*
Lactarius trivialis Fr. Sept. 9, 1905, *2096.*
Lactarius vellereus Fr. Aug. 3, 1902, *153.*
Lactarius volemus Fr. Aug. 3, 1902, *160;* Aug. 2, 1903, *1424.*
Lepiota naucinoides Pk. Sept. 5, 1905, *2102.*
Lepiota procera Scop. Aug. 15, 1903, *1465-1468.*
Marasmius oreades Fr. Aug. 15, 1903, *1482.*
Marasmius scorodonius Fr. Aug. 14, 1904, *1868.*
Panaeolus campanulatus Linn. June 22, 1903, *1312, 1313.*
Russula compacta Frost Aug. 14, 1910, *2525.*
Russula virescens Fr. Sept. 10, 1905, *2111.*
Schizophyllum commune Fr. June 22, 1903, *1309.*
Volvaria bombycina Schaeff Aug. 22, 1916, *2705.*

GASTEROMYCETES

Bovista plumbea Pers. Sept. 6, 1903, *1552.*
Calvatia lilicina Berk. Sept. 10, 1905, *2124.*
Geaster hygrometricus Pers. Aug. 24, 1902, *422.*
Lycoperdon cruciatum Rostk. Sept. 6, 1903, *1553-1555;* Sept. 10, 1905, *2105;* Aug. 7, 1910, *2514.*
Lycoperdon umbrinum Pers. Sept. 10, 1905, *2104.*
Scleroderma geaster Fr. Sept. 7, 1902, *606, 607;* Sept. 6, 1903, *1557, 1558;* Sept. 6, 1904, *1866.*
Scleroderma vulgare Pers. Aug. 17, 1902, *352.*

East Hartford, Connecticut

A Contribution to our Knowledge of the Wild and Cultivated Flora of Massachusetts—I

HAROLD N. MOLDENKE

The present paper comprises an annotated list of 223 collections of Massachusetts plants, representing 192 species and subspecific entities in 155 genera and 72 botanical families. It is one of a series by the same author on the flora of each of the states of the United States, with the primary purpose in view of recording county records for each species for the use of future compilers of state Floras giving the distribution of each species in the state by counties.[1] The sequence of families followed is that of the author's preliminary classification of the Plant Kingdom, based on the systems of Engler & Diels and of J. Hutchinson.[2]

It is a pleasure to acknowledge the generous and valuable assistance rendered the author by the following renowned specialists, who have examined material of the groups noted after their names: Mr. E. J. Alexander (*Impatiens*), Dr. C. H. K. Blom (*Stachys*), Dr. Wendell H. Camp (*Vaccinium*), Dr. Henry A. Gleason (*Echinochloa*), Dr. Francis W. Pennell (*Verbascum*), Dr. John H. Pierce (*Sagittaria*), and Dr. Henry K. Svenson (*Carex*). Each collection cited on the following pages which was examined by one of these specialists has the name of the specialist following the number in the list.

The first set of specimens herein cited is deposited in the Britton Herbarium at The New York Botanical Garden; other sets are in the herbaria of the University of Pennsylvania, University of Illinois, Missouri Botanical Garden, Duke University, Carthage College, Cornell University, Naturhistoriska Riksmuseum in Stockholm, Royal Botanic Gardens in Kew, Botanisches Museum in Berlin, Botaniska Trädgard in Göteborg, Conservatoire Botanique in Geneva, Jardin Botanique de l'Etat in Brussels, British Museum (Natural History) in London, the herbaria at Krakow and Vyskov, and elsewhere. The collection numbers, for citation purposes, are all H. N. Moldenke collection and citation numbers, although some of the material was actually collected by other collectors and turned over to the author of this paper for identification and distribution. These other collectors, with the numbers of their collections and the dates when they collected in Massachusetts, are as follows: Miss Ellys T. Butler, 1934 (*8246*); Mr. Stanley Conyes, 1942 (*13313*); Miss Alma L. Ericson, 1932, 1938, 1939, 1941, 1942 (*10750, 11690—11708, 11776—11779,*

[1] MOLDENKE, H. N., A contribution to our knowledge of the wild and cultivated flora of Ohio—I. Castanea **9**: 1—80. 1944; A contribution to our knowledge of the wild and cultivated flora of Florida—I. American Midland Naturalist **32**: 529-590. 1945.

[2] MOLDENKE, H. N., A preliminary classification of the plant kingdom to families, pp. 1-37. New York Botanical Garden, February 11, 1944.

13892—13893, 13897—13902, 16879—16897, 16899, 16950—16991); Dr. Charles E. Moldenke & Mrs. Sophia M. Moldenke, 1931 (*1619*);[3] and Mrs. S. S. Vanderbilt, 1938, 1940, 1941 (*10751, 11367, 11507—11508, 11518, 11866—11870*).

Whenever the identification given here or the nomenclature here employed differs from that on the labels of the material when distributed, this fact is noted so that herbarium curators may make the necessary corrections, if they so desire. Where it differs from that of the author's previously published classified list of collections,[4] this fact is also noted on the following pages.

USTILAGINACEAE

Ustilago zeae (Beckmann) Unger—*Berkshire Co.:* on *Zea mays* in garden, Northrop Camp, Mount Washington, *11864.*

OPHIOGLOSSACEAE

Osmundopteris virginiana (L.) Small—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *11702, 16951.*

POLYPODIACEAE

Adiantum pedatum L.—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16956.*

Anchistea virginica (L.) Presl—*Berkshire Co.:* in marshy ground, Northrop Camp, Mount Washington, *16960.*

Asplenium trichomanes L.—*Franklin Co.:* in rock crevices of cliff, Mount Toby, near Sunderland, *9652.*

Dryopteris intermedia (Muhl.) A. Gray—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16952.*

Dryopteris marginalis (L.) A. Gray—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16955.*

Lorinseria areolata (L.) Presl—*Berkshire Co.:* in marshy ground, Northrop Camp, Mount Washington, *16959.*

Pteridium latiusculum (Desv.) Hieron.—*Berkshire Co.:* forming large colonies in dense woodlands, Northrop Camp, Mount Washington, *16894, 16957.*

OSMUNDACEAE

Osmunda cinnamomea L.—*Franklin Co.:* in meadows, Deerfield, *9632.*

Osmunda cinnamomea var. frondosa A. Gray—*Franklin Co.:* among typical form in meadows, Deerfield, *9636.*

Osmunda claytoniana L.—*Berkshire Co.:* in moist soil in dense woods, Northrop, Camp, Mount Washington, *16953.*

[3] Dictionary of American Biography **13:** 79. 1931; Science, new ser., **81:** 191. 1935; National Cyclopaedia of American Biography **24:** 54-55. 1935; Encyclopedia of American Biography **4:** 292-294. 1935; White's Conspectus of American Biography, ed. 2, 307. 1937; Who Was Who in America **1:** 853. 1942.

[4] Moldenke, H. N., An annotated and classified list of H. N. Moldenke collection numbers from no. 1 to no. 11,277, inclusive, pp. 1-135. New York Botanical Garden, December 6, 1939.

LYCOPODIACEAE

LYCOPODIUM CLAVATUM L.—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16954.*

LYCOPODIUM FLABELLIFORME (Fernald) Blanchard—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16958.*

LYCOPODIUM OBSCURUM var. DENDROIDEUM (Michx.) D. C. Eaton—*Berkshire Co.:* in dark woods, Northrop Camp, Mount Washington, *11698.*

TAXACEAE

TAXUS CANADENSIS Marsh.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16891.*

RANUNCULACEAE

ANEMONE CANADENSIS L.—*Berkshire Co.:* wild or naturalized in grassy meadow near old dwelling, Mount Washington, *11638.*

ANEMONE CYLINDRICA A. Gray—*Berkshire Co.:* in woods along margins of wood roads, Mount Washington, *11637.*

ANEMONELLA THALICTROIDES (L.) Spach—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16972. Franklin Co.:* in dark woods on mountain slope, Mount Toby, near Sunderland, *9656,* cited on page 34 of the Classified List as *Syndesmon thalictroides* (L.) Hoffmgg. and so distributed.

CLEMATIS VIRGINIANA L.—*Berkshire Co.:* along fencerows, roadsides, and thickets, Mount Washington, *11701.*

RANUNCULUS ACRIS L.—*Franklin Co.:* in meadows, Deerfield, *9635.*

THALICTRUM DIOICUM L.—*Berkshire Co.:* on woodland banks and in woods, Northrop Camp, Mount Washington, *16950, 16974. Franklin Co.:* in woods on slope of mountain, Mount Toby, near Sunderland, *9640, 9641.*

THALICTRUM POLYGAMUM Muhl.—*Berkshire Co.:* in wet meadows, Mount Washington, *11632.*

PODOPHYLLACEAE

VANCOUVERIA HEXANDRA (Hook.) Morr. & Decaisne—*Franklin Co.:* naturalized in deep woods, Greenfield, *11367.*

BRASSICACEAE

ARABIS LAEVIGATA (Muhl.) Poir.—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16975.*

ARABIS PYCNOCARPA Hopkins—*Franklin Co.:* at edge of embankment, Mount Toby, near Sunderland, *9644.*

BRASSICA KABER (P. DC.) Wheeler—*Berkshire Co.:* weed in cornfields, South Egremont, *11739.*

CAPSELLA BURSA-PASTORIS (L.) Medic.—*Berkshire Co.:* in waste ground, Northrop Camp, Mount Washington, *16981.*

CARDAMINE PRATENSIS var. PALUSTRIS Wimm. & Grab.—*Berkshire Co.:* in meadows, Lenox, *11537.*

RAPHANUS SATIVUS L.—*Berkshire Co.:* in outdoor cultivation and escaped near gardens, Northrop Camp, Mount Washington, *11839.*

SISYMBRIUM OFFICINALE var. LEIOCARPUM P. DC.—*Berkshire Co.:* in waste and cultivated ground, Northrop Camp, Mount Washington, *11666* distributed as *Erysimum officinale* var. *leiocarpum* (P. DC.) Farwell.

VIOLACEAE

VIOLA AFFINIS Le Conte—*Franklin Co.:* in woods, Johnson Homestead, Shelburne Falls, *11870.*

VIOLA BLANDA Willd.—*Franklin Co.:* in dark woods on mountain slope, Mount Toby, near Sunderland, *9643.*

VIOLA CONSPERSA Reichenb.—*Franklin Co.:* in dark woods on mountain slope, Mount Toby, near Sunderland, *9642.*

VIOLA PAPILIONACEA Pursh—*Berkshire Co.:* in meadows, Northrop Camp, Mount Washington, *16983.*

VIOLA PEDATA var. LINEARILOBA P. DC.—*Hampshire Co.:* in sandy pine woods, Easthampton, *9658.*

POLYGALACEAE

TRICLISPERMA PAUCIFOLIA (Willd.) Nieuwl.—*Franklin Co.:* in dark woods on mountain slope, Mount Toby, near Sunderland, *9654.*

PARNASSIACEAE

PARNASSIA CAROLINIANA Michx.—*Berkshire Co.:* in meadows and wet ditches, South Egremont, *11737;* in springy ground in field, Northrop Camp, Mount Washington, *16881.*

CARYOPHYLLACEAE

DIANTHUS BARBATUS L.—*Berkshire Co.:* escaped and naturalized in fields, Mount Washington, *11650.*

SAPONARIA OFFICINALIS L.—*Berkshire Co.:* along roadsides, Northrop Camp, Mount Washington, *16987.*

SILENE CUCUBALUS Wibel—*Berkshire Co.:* very abundant in fields, South Egremont, *11671,* distributed as *S. latifolia* (Mill.) Britten & Rendle.

MOLLUGINACEAE

MOLLUGO VERTICILLATA L.—*Franklin Co.:* in dry sandy soil along roadsides, Northfield, *8841.*

ALSINACEAE

ALSINE LONGIFOLIA (Muhl.) N. L. Britton—*Berkshire Co.:* in moist meadows, Mount Washington, *11641.*

PORTULACACEAE

CLAYTONIA VIRGINICA L.—*Berkshire Co.:* in moist woods, Northrop Camp, Mount Washington, *16971.*

POLYGONACEAE

ACETOSELLA VULGARIS Fourr.—*Franklin Co.:* in dry fields, Mount Toby, near Sunderland, *9639.*

BILDERDYKIA SCANDENS (L.) Greene—*Franklin Co.:* climbing over low shrubs along roadsides and fencerows, Northfield, *8838.*

FAGOPYRUM ESCULENTUM Gaertn.—*Berkshire Co.:* escaped along roadsides and fencerows, Northrop Camp, Mount Washington, *16989.*

REYNOUTRIA SACHALINENSIS (F. Schmidt) Nakai—*Berkshire Co.:* in outdoor cultivation and escaped, South Egremont, *11742.*

CHENOPODIACEAE

AMBRINA AMBROSIOIDES (L.) Spach—*Berkshire Co.:* in waste ground, Northrop Camp, Mount Washington, *16988.*

BETA VULGARIS var. CICLA L.—*Berkshire Co.:* in outdoor cultivation, Northrop Camp, Mount Washington, *11838.*

GERANIACEAE

GERANIUM MACULATUM L.—*Franklin Co.:* in sunny meadows, Deerfield, *9634.*

OXALIDACEAE

OXALIS MONTANA Raf.—*Berkshire Co.:* in dark woods, Mount Washington, *11652.*

BALSAMINACEAE

IMPATIENS ROYLEI Walp.—*Berkshire Co.:* in wet meadow at base of Cliff, outskirts of Great Barrington, *11518,* first record from the state, plants 5-6 feet tall, flowers pink, det. Alexander.

OENOTHERACEAE

CHAMAENERION SPICATUM (Lam.) S. F. Gray—*Berkshire Co.:* along wood roads, Northrop Camp, Mount Washington, *11679.*

OENOTHERA MURICATA L.—*Berkshire Co.:* along roadsides, Mount Washington, *11664.*

HYPERICACEAE

HYPERICUM CANADENSE L.—*Franklin Co.:* in dry fields, Johnson Homestead, Shelburne Falls, *11869.*

HYPERICUM PERFORATUM L.—*Berkshire Co.:* in fields, Mount Washington, *11636.*

MALVACEAE

MALVA NEGLECTA Wallr.—*Berkshire Co.:* along roadsides and in waste places, Northrop Camp, Mount Washington, *11705.*

EUPHORBIACEAE

ACALYPHA RHOMBOIDEA Raf.—*Berkshire Co.:* in hedgerows, Northrop Camp, Mount Washington, *16985.*

ACALYPHA VIRGINICA L.—*Franklin Co.:* in waste ground, Johnson Homestead, Shelburne Falls, *11868.*

GALARHOEUS CYPARISSIAS (L.) Small—*Berkshire Co.:* along margin of Turtle Pond, in dense colony, South Egremont, *11691.*

HYDRANGEACEAE

PHILADELPHUS CORONARIUS L.—*Berkshire Co.:* in outdoor cultivation and persistent near old habitations, Northrop Camp, Mount Washington, *16879.*

ROSACEAE

DASIPHORA FRUTICOSA (L.) Rydb.—*Berkshire Co.:* in rocky fields, Mount Washington, *11634, 11699.*

FILIPENDULA ULMARIA (L.) Maxim.—*Berkshire Co.:* escaped from cultivation, Northrop Camp, Mount Washington, *11644.*

GEUM ALEPPICUM var. STRICTUM (Ait.) Fernald—*Berkshire Co.:* along margins of old wood roads, Mount Washington, *11656,* distributed as *G. strictum* Ait.

GEUM CANADENSE Jacq.—*Berkshire Co.:* along margins of old wood roads, Mount Washington, *11657.*

RUBUS IDAEUS var. ACULEATISSIMUS (C. A. Mey.) Regel & Tilling—*Berkshire Co.:* naturalized in thickets and hedgerows, Northrop Camp, Mount Washington, *11662.*

SIBBALDIOPSIS TRIDENTATA (Soland.) Rydb.—*Berkshire Co.:* on summit of Mount Washington, Mt. Everett Reservation, *10750;* on barren windswept rocks, Sunset Rock, Mount Washington, *11680, 13900;* among rocks on windswept summit of Mount Everett, *16897.*

SPIRAEA LATIFOLIA (Ait.) Borkh.—*Berkshire Co.:* in fields and marshy meadows, Northrop Camp, Mount Washington, *11635, 16892.*

SPIRAEA TOMENTOSA L.—*Berkshire Co.:* in fields and meadows, Northrop Camp, Mount Washington, *11703, 16887.*

MALACEAE

AMELANCHIER LAEVIS Wiegand—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16966.*

ARONIA PRUNIFOLIA (Marsh.) Rehd.—*Franklin Co.:* along roadsides, Mount Toby, near Sunderland, *9650,* distributed as *A. floribunda* (Lindl.) Spach.

AMYGDALACEAE

PADUS VIRGINIANA (L.) Mill.—*Berkshire Co.:* along fencerows, Northrop Camp, Mount Washington, *16963. Hampshire Co.:* at margins of woodlands, Easthampton, *9660.*

CAESALPINIACEAE

CHAMAECRISTA NICTITANS (L.) Moench—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16986.*

FABACEAE

AMPHICARPA BRACTEATA (L.) Fernald—*Franklin Co.:* climbing on weeds and bushes in woods, Northfield, *8847,* cited on page 62 of the Classified List as *A. monoica* (L.) Ell. and so distributed.

BAPTISIA TINCTORIA (L.) Vent.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16899.*

LUPINUS PERENNIS L.—*Hampshire Co.:* in dry sandy pine woods, Easthampton, *9659.*

MEDICAGO LUPULINA L.—*Berkshire Co.:* in fields and lawns, Pittsfield, *8246.*

PHASEOLUS LIMENSIS var. LIMENANUS L. H. Bailey—*Berkshire Co.:* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *11831.*

PHASEOLUS VULGARIS var. HUMILIS Alef.—*Berkshire Co.:* escaped from cultivation in waste ground, South Egremont, *11743;* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *11833.*

SOJA MAX (L.) Piper—*Berkshire Co.:* escaped from cultivation in waste ground, South Egremont, *11744;* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *11837.*

TRIFOLIUM AGRARIUM L.—*Berkshire Co.:* in grassy meadows, Northrop Camp, Mount Washington, *16991.*

TRIFOLIUM PRATENSE L.—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *16979.*

SALICACEAE

POPULUS TACAMAHACCA Mill.—*Berkshire Co.:* by spring, Northrop Camp, Mount Washington, *11642.*

Populus virginiana Foug.—*Berkshire Co.:* along roadsides, Copake road, Mount Washington, *11643,* distributed as *P. canadensis* Michx. f.

BETULACEAE

Alnus alnobetula (Ehrh.) K. Koch—*Berkshire Co.:* on exposed rocks, Lookout Point, Mount Washington, *11663.*

Alnus incana (L.) Moench—*Berkshire Co.:* in alder swamps, Northrop Camp, Mount Washington, *11667.*

Betula lenta L.—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16965.*

CORYLACEAE

Corylus cornuta Marsh.—Berkshire Co.: in thickets, at borders of fields, and along woodland trails, Northrop Camp, Mount Washington, *11661, 16896.*

FAGACEAE

Castanea dentata (Marsh.) Borkh.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16884.*

Fagus grandifolia Ehrh.—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16964.*

Quercus ilicifolia Wang.—*Franklin Co.:* on mountainslope, Mount Toby, near Sunderland, *9647.*

ULMACEAE

Ulmus americana L.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16885.*

RHAMNACEAE

Ceanothus americanus L.—*Berkshire Co.:* at margins of woods, Northrop Camp, Mount Washington, *16882.*

ACERACEAE[5]

Acer spicatum Lam.—*Franklin Co.:* in woods on mountainslope, Mount Toby, near Sunderland, *9648.*

Saccharodendron saccharum (Marsh.) Moldenke—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16893.*

ANACARDIACEAE

Rhus typhina Torner—*Berkshire Co.:* in thickets bordering fields, Northrop Camp, Mount Washington, *16962.*

CORNACEAE

Chamaepericlymenum canadense (L.) Aschers. & Graebn.—*Berkshire Co.:* in woods, Mount Washington, *11693.*

AMMIACEAE

Angelica atropurpurea L.—*Berkshire Co.:* in swamps, Mount Washington, *11646.*

Cicuta maculata L.—*Berkshire Co.:* in swamps and along streams, Mount Washington, *11647.*

Levisticum officinale W. Koch—*Berkshire Co.:* in outdoor cultivation and persistent, Northrop Camp, Mount Washington, *11645.*

[5] The specimen of *Acer pseudoplatanus* L., *9468,* cited on page 74 of the Classified List as from Massachusetts, was actually collected in Norway.

PASTINACA SATIVA var. SYLVESTRIS P. DC.—*Berkshire Co.:* abundant along roadsides, South Egremont, *11676.*

PETROSELINUM CRISPUM var. CRISPUM (Mill.) Airy-Shaw—*Berkshire Co.:* in outdoor cultivation, Northrop Camp, Mount Washington, *11836.*

PYROLACEAE

ORTHILIA SECUNDA (L.) House—*Berkshire Co.:* in dark woods, Mount Washington, *11649,* inaccurately distributed as *"Orthilla secunda."*

PYROLA ELLIPTICA Nutt.—*Berkshire Co.:* in dense dark woodlands, Mount Washington, *11648, 13898.*

ERICACEAE

ARSENOCOCCUS LIGUSTRINUS (L.) Small—*Berkshire Co.:* along margins of wood roads, Mount Washington, *11651.*

AZALEA PRINOPHYLLA Small—*Franklin Co.:* in woods on slope of Mount Toby, near Sunderland, *9645.*

CHAMAEDAPHNE CALYCULATA (L.) Moench—*Essex Co.:* in woods along roadside, Newburyport, *1619.*

EPIGAEA REPENS L.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16961.*

GAULTHERIA PROCUMBENS L.—*Berkshire Co.:* in dense woodlands, Mount Washington, *13899.*

VACCINIACEAE

CYANOCOCCUS VACILLANS (Kalm) Rydb.—*Franklin Co.:* along roadsides, Mount Toby, near Sunderland, *9651,* det. by Camp as *Vaccinium vacillans* Soland. and so distributed, cited on page 79 of the Classified List as *"C. vacillans* (Soland.) Rydb."

MONOTROPACEAE

MONOTROPA UNIFLORA L.—*Berkshire Co.:* in dense woodlands, Mount Washington, *11629, 13897.*

OLEACEAE

FRAXINUS AMERICANA L.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16883.*

APOCYNACEAE

APOCYNUM ANDROSAEMIFOLIUM L.—*Berkshire Co.:* along margins of old wood roads, Mount Washington, *11640.*

ASCLEPIADACEAE

ASCLEPIAS EXALTATA (L.) Muhl.—*Berkshire Co.:* along margins of old wood roads, Mount Washington, *11654, 11707.*

ASCLEPIAS INCARNATA L.—*Berkshire Co.:* in swamps, South Egremont, *11675;* at margin of Turtle Pond, near South Egremont, *11692;* in moist meadows, Mount Washington, *13902.*

ASCLEPIAS SYRIACA L.—*Berkshire Co.:* along woodland roads and fencerows, Mount Washington, *11706.*

RUBIACEAE

GALIUM TINCTORIUM L.—*Berkshire Co.:* in alder swamps, Northrop Camp, Mount Washington, *11668.*

CAPRIFOLIACEAE

DIERVILLA LONICERA Mill.—*Berkshire Co.:* in woods, Mount Washington, *11627.*

LONICERA DIOICA L.—*Berkshire Co.:* in woods, Mount Washington, *11628.* Franklin Co.: in woods in slope of Mount Toby, near Sunderland, *9646.*

VIBURNUM LANTANOIDES Michx.—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16888.*

VIBURNUM TRILOBUM Marsh.—*Berkshire Co.:* at edge of woods and by spring in clearing, Mount Washington, *11653.*

CICHORIACEAE

HIERACIUM AURANTIACUM L.—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *11776, 16982.*

HIERACIUM PRATENSE Tausch—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *11777.*

LACTUCA SATIVA var. CRISPA L.—*Berkshire Co.:* persistent or escaped from cultivation near garden, Northrop Camp, Mount Washington, *11840.*

TRAGOPOGON PRATENSIS L.—*Berkshire Co.:* at edge of fields, Northrop Camp, Mount Washington, *11660.*

AMBROSIACEAE

AMBROSIA ELATIOR L.—*Berkshire Co.:* in waste ground and along roadsides, Northrop Camp, Mount Washington, *16970.*

CARDUACEAE

ASTER LAEVIS L.—*Franklin Co.:* in grassy fields, Northfield, *8842.*

ASTER RAMOSISSIMUS Mill.—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *16984.*

CENTAUREA CYANUS L.—*Berkshire Co.:* in outdoor cultivation and escaped from cultivation, Northrop Camp, Mount Washington, *11834.*

CENTAUREA MACULOSA Lam.—*Berkshire Co.:* abundant in fields, South Egremont, *11694;* in dry abandoned fields, Mount Washington, *13313, 13901.*

COREOPSIS TINCTORIA NUTT.—*Berkshire Co.:* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *13892.*

COSMOS BIPINNATUS Cav.—*Berkshire Co.:* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *11835, 13893.*

ERIGERON PULCHELLUS Michx.—*Franklin Co.:* in fields and along roadsides, Deerfield, *9629.*

EUPATORIUM PERFOLIATUM L.—*Berkshire Co.:* in marshy ground by spring, Northrop Camp, Mount Washington, *16886.*

IONACTIS LINARIIFOLIUS (L.) Greene—*Franklin Co.:* in dry soil of pine and oak woods, Northfield, *8839.*

MATRICARIA SUAVEOLENS (Pursh) Buch.—*Berkshire Co.:* abundant weed in barnyards, Mount Washington, *11665.*

SENECIO PAUPERCULUS var. BALSAMITAE (Muhl.) Fernald—*Franklin Co.:* at spring by cliffs, Mount Toby, near Sunderland, *9655,* distributed as *S. balsamitae* Muhl.

SOLIDAGO ALTISSIMA L.—*Franklin Co.:* along ditches, Northfield, *8845.*

SOLIDAGO BICOLOR L.—*Berkshire Co.:* in dense woods, Northrop Camp, Mount Washington, *16977.*

SOLIDAGO JUNCEA Ait.—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *16980.*

Solidago nemoralis Ait.—*Franklin Co.:* in dry fields, Northfield, *8843.*

Solidago serotina Ait.—*Franklin Co.:* in marshy soil along brooks, Northfield, *8844.*

Zinnia haageana Regel—*Berkshire Co.:* in outdoor cultivation and escaped in waste ground, Northrop Camp, Mount Washington, *11832.*

GENTIANACEAE

Anthopogon procerus (Holm) Rydb.—*Franklin Co.:* in meadows, Johnson Homestead, Shelburne Falls, *11866.*

Dasystephana andrewsii (Griseb.) Small—*Berkshire Co.:* in moist fields and near springs, Northrop Camp, Mount Washington, *11779, 16978.*

PRIMULACEAE

Lysimachia quadrifolia L.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16895.*

Lysimachia terrestris (L.) B.S.P.—*Berkshire Co.:* in swamps, South Egremont, *11674.*

Steironema ciliatum (L.) Raf.—*Berkshire Co.:* along old wood roads, Mount Washington, *11655.*

CAMPANULACEAE

Campanula rotundifolia L.—*Berkshire Co.:* in grassy fields, Mount Washington, *11631.*

LOBELIACEAE

Lobelia spicata Lam.—*Berkshire Co.:* in fields, Mount Washington, *11639.*

SCROPHULARIACEAE

Chelone glabra L.—*Berkshire Co.:* along brooks, Northrop Camp, Mount Washington, *11778.*

Gerardia paupercula (A. Gray) N. L. Britton—*Franklin Co.:* in meadows, Johnson Homestead, Shelburne Falls, *11867,* distributed as *Agalinis paupercula* (A. Gray) Britton.

Melampyrum lineare var. latifolium (Muhl.) Beauverd—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *11659.*

Pedicularis canadensis L.—*Berkshire Co.:* in fields, Mount Washington, *11700.*

Penstemon laevigatus Soland.—*Berkshire Co.:* in fields, South Egremont, *11678.*

Verbascum phlomoides L.—*Franklin Co.:* abundant near dairy farm along banks of the Deerfield River, Shelburne Falls, *10751,* verif. Pennell, *11272,* verif. Pennell.

Veronicastrum virginicum (L.) Farwell—*Berkshire Co.:* in meadows, Mount Washington, *11690.*

VERBENACEAE

Verbena hastata L.—*Berkshire Co.:* along roadsides, South Egremont, *11673. Franklin Co.:* along roadsides, Northfield, *8846.*

Verbena hastata f. albiflora Moldenke[6]—*Berkshire Co.:* in pastures, South Egremont, *11741.*

Verbena urticifolia L.—*Berkshire Co.:* along roadsides, South Egremont, *11740.*

[6] This interesting albino form was first recorded from the area by Dr. William A. Weber in his manuscript list of the flora of Northrop Camp and vicinity, but was not given a formal name there. It is known also from Wyoming Co., New York.

LAMIACEAE

Leonurus cardiaca L.—*Berkshire Co.:* along fencerows, Northrop Camp, Mount Washington, *16967.*

Monarda didyma L.—*Berkshire Co.:* in fields and along roadsides, Northrop Camp, Mount Washington, *16889.*

Origanum vulgare L.—*Franklin Co.:* in grassy fields, Greenfield, *11507.*

Prunella vulgaris var. lanceolata (Bart.) Fernald—*Berkshire Co.:* at margins of woods, Northrop Camp, Mount Washington, *16890.*

Stachys palustris L.—*Berkshire Co.:* along roadside hedges, South Egremont, *11670,* det. Blom, distributed as *Teucrium occidentale* A. Gray.

ALISMACEAE

Sagittaria latifolia f. *d.* J. G. Sm.—*Berkshire Co.:* at edge of lake, South Egremont, *11738,* det. Pierce.

ERIOCAULACEAE

Eriocaulon septangulare With.—*Berkshire Co.:* in pond, Guilder Pond, Mount Everett, *11708.*

MELANTHIACEAE

Veratrum viride Ait.—*Franklin Co.:* in meadows, Deerfield, *9633.*

LILIACEAE

Lilium canadense L.—*Berkshire Co.:* in meadows, South Egremont, *11672.*

Lilium philadelphicum L.—*Berkshire Co.:* in woods along margins of wood roads, Mount Washington, *11633.*

CONVALLARIACEAE

Clintonia borealis (Ait.) Raf.—*Berkshire Co.:* in dense woods, Mount Washington, *11630, 11695.*

Smilacina racemosa (L.) Desf.—*Berkshire Co.:* in woodlands, Northrop Camp, Mount Washington, *16969.*

Uvularia perfoliata L.—*Berkshire Co.:* in woods, Mount Washington, *11658.*

TRILLIACEAE

Trillium erectum L.—*Berkshire Co.:* in woods, Northrop Camp, Mount Washington, *16973.*

ARACEAE

Orontium aquaticum L.—*Berkshire Co.:* in quiet water of pond, Northrop Camp, Mount Washington, *16968.*

IRIDACEAE

Iris versicolor L.—*Franklin Co.:* in wet marshy meadows, Deerfield, *9638.*

DIOSCOREACEAE

Dioscorea paniculata Michx.—*Berkshire Co.:* climbing over shrubs in thickets, Northrop Camp, Mount Washington, *16990.*

ORCHIDACEAE

Blephariglottis psycodes (L.) Rydb.—*Berkshire Co.:* in marshy ground, Northrop Camp, Mount Washington, *16880.*

Corallorrhiza trifida Chatelain—*Berkshire Co.:* in dense dark woods, Mount Washington, *11697.*

Fissipes acaulis (Ait.) Small—*Franklin Co.:* in open woods, Mount Toby, near Sunderland, *9649.*

Serapias helleborine L.—*Franklin Co.:* in swampy ground, Greenfield, *11508.*

CYPERACEAE

Carex cristatella N. L. Britton—*Franklin Co.:* in woods by spring and rock ledges, Mount Toby, near Sunderland, *9657.*

Carex platyphylla Carey—*Franklin Co.:* at spring in woods by cliffs, Mount Toby, near Sunderland, *9653,* det. Svenson.

Carex stricta Lam.—*Franklin Co.:* abundant in marshy meadow, Deerfield, *9637,* det. Svenson.

Carex versicaria L.—*Franklin Co.:* abundant in meadow at edge of marsh, Deerfield, *9630,* det. Svenson.

Cyperus strigosus L.—*Franklin Co.:* in dry sandy soil along roadsides, Northfield, *8840.*

Eleocharis capitata var. borealis Svenson—*Franklin Co.:* growing in 3 inches of water at edge of marsh, Deerfield, *9631,* det. Svenson, distributed as *E. capitata* (L.) R. Br.

Scirpus heterochaetus Chase—*Berkshire Co.:* in margin of Turtle Pond, South Egremont, *11704.*

POACEAE

Anthoxanthum odoratum L.—*Berkshire Co.:* in grassy fields, Northrop Camp, Mount Washington, *16976.*

Echinochloa pungens (Poir.) Rydb.—*Franklin Co.:* in waste ground along roadsides, Northfield, *8848,* det. Gleason, distributed as "*E. crusgalli* (L.) Beauv."

Panicum capillare L.—*Franklin Co.:* in waste soil along ditches, Northfield, *8849.*

Box 240, North Warren
Pennsylvania

BOOK REVIEWS

Travelers All

Travelers All, How Plants Go Places. By Irma E. Webber, 32 pp. Figures in color on each page. New York: William R. Scott, Inc. 1944. $1.25.

Dr. Webber's book is a charming survey of seed and fruit dispersal presented in a manner that easily captivates the interests of youngsters and even teen age students. In it the author illustrates colorfully, accurately and attractively all of the common methods of dispersal by examples of well known or wide spread plants. The text is written simply and interestingly. Although vocabulary and interest levels are planned with the elementary school child in mind, this little book could serve well, when the plants themselves are not available, as illustrative material for the junior high and senior high school student especially in large cities where plants are so little known. Obvious effort was carefully exerted to avoid any botanical errors. But the most amateur zoologist or even John Doe would wince at the blue eyed, red headed, white squirrel eating an acorn on page 27. "Travelers All" is a welcome addition to any home, school or public library where young people come in with eager eyes and questions.

Alma L. Moldenke

Evander Childs High School
New York, N. Y.

A Canoe Trip in the Far North

The Arctic Prairies. By Ernest Thompson Seton. xi + 308 pp. Illustrated. New York: International University Press. Republished 1943. $3.50.

In the summer of 1927, while traveling along the north shore of McLeod Bay in Great Slave Lake, we came upon the inscription "Seton 1907" blazoned on the vertical faces of the cliffs. The inscription marked Mr. Seton's journey to the "Barren Grounds," described and illustrated in his delightful book, "The Arctic Prairies" (Scribner's, 1911). It is a pleasure to welcome a new printing of this volume (International University Press, 1943), and to pay tribute to its author. The book is of particular value in these days when thousands of people are having to adjust themselves to life in the subarctic wilderness. For the book is more than a mere chronology of events; it is an authentic, living account of the country and of the author's reactions to it.

By some stroke of good fortune my wife and I acquired and read "The Arctic Prairies" before ever we embarked upon our botanical journeyings in the Mackenzie country. I say good fortune because I am not sure that we

should have continued beyond that first raid had it not been for the sound advice contained in Mr. Seton's account of his experiences with weather, mosquitoes, and transportation problems. We heartily recommend it to anyone who contemplates venturing into the Mackenzie basin wilderness in summer. In fact, it might almost be considered required reading.

Seton was accompanied, in 1907, by Mr. E. A. Preble of the U. S. Biological Survey. Preble had already traveled extensively in the Mackenzie country, having made long collecting journeys in 1901 and again in 1903-04. His "Biological Investigation of the Athabaska-Mackenzie Region," published in 1908 as No. 27 in the North American Fauna Series remains to this day an indispensable guide for anyone undertaking biological work in that region.

"The Arctic Prairies" can be divided roughly into three parts. First is a description of preparations for the trip, and of the trip itself as far north as McMurray on the lower Athabaska River at the mouth of the Clearwater. Modern travelers will find but little in this part that applies directly to what they themselves will see, for Seton followed the old route by way of Athabaska Landing. A railway now carries traffic from Edmonton to Waterways on the Clearwater River, which is the present head of navigation on the Mackenzie system. The old route was a venturesome one, for it necessitated passing a series of rapids in the Athabaska between Athabaska Landing and the mouth of the Clearwater.

The second part of the story is an account of the canoe and boat journey down the Athabaska and Slave Rivers to Fort Smith; and it also tells of the author's adventures in his hunt for woodland bison in the country west of the Slave River. This country is now a part of the Wood Buffalo Park, a vast game preserve set up for the perpetuation of the dwindling native herds of bison. Seton's description of the country and his discussion of the bison are of great significance; for they were done at a critical time in the history of the wild herds, when the latter had about reached their lowest ebb. Thanks to modern protection they have now increased greatly.

It is in the second part of the book that the chapter on mosquitoes and flies appears (Chap. IX). This chapter is a gem, that should be read by any prospective northern traveler whether or not he reads any other part of the book. It is probably the best description that has ever been written of the unmitigated summer nightmare of mosquitoes and flies. Its only competitor, in my opinion, is an account put down by the ill-fated Hood, on the occasion of the first Franklin Expedition; but this is deeply buried in the narrative of that journey, and inaccessible to most readers. It is impossible to emphasize too strongly the need for adequate preparation, on the part of travelers, against the mosquito pest. This is especially true for anyone engaged in botanical work that must be done in summer. It is not overstating the case to say that the efficiency of an expensive and otherwise carefully planned expedition can be cut to a half

or a quarter of what it should be if the plans and equipment do not provide against the mosquitoes.

Approximately the last half of the book is a description of the trip through the eastern arm of Great Slave Lake and into the Lockhart River basin. It was on this part of the journey, probably on the way eastward, that Seton climbed the shore cliffs to scratch his name and the date. He did not actually carve the rock, but only scraped off the lichens that covered it. These lichens are large leaf-like affairs (of the genus *Gyrophora*), nearly black and very brittle when dry. When they are scraped off, the light-colored igneous rocks are exposed. They grow very slowly, so that inscriptions made by this method will be clear for a long time. We climbed up to Seton's name, to see how much they had grown in twenty years, and found that they had scarcely more than started to recover the exposed rock.

Traveling on the lake by canoe is not nearly so hazardous now as it was when Seton and Preble made their journey. In spite of the fact that much of the route through the East Arm is in narrow channels among the islands, there are still some open water crossings of several miles that must be made in calm weather. Seton and his party had to paddle these crossings, whereas they can now be made in much less time with outboard motors. Furthermore there are now excellent maps, not only of the complex island system of the main lake, but also of Artillery, Clinton-Colden, Aylmer, and other lakes in the Lockhart basin.

Seton's descriptions and sketches of the country and its natural history are authentic and lively. The first edition of "The Arctic Prairies" contained, in an appendix, a list of plants collected by himself and Preble. This collection, now in the National Herbarium at Ottawa, forms a material base for checking the botanical field observations noted in the book. Descriptions of villages and people are not so applicable to the modern scene; for vast changes have occurred due to the development of mining interests and air transport. Seton's Fort Smith is scarcely recognizable anymore, situated as it is on main air- and water-routes to the oil fields of the Mackenzie and to the mineral deposits of Great Slave and Great Bear Lakes. Local families, on the other hand, such as the Loutits and Beaulieus, of which the author writes a great deal, are still very much in evidence. Seton's guide, Billy Loutit, when last we saw him (1939), was mate on the Hudson's Bay Company steamer *Distributor,* plying between Fort Smith and Aklavik. The author devotes a chapter (XXIII), and rightly so, to the dog situation, painting a pretty unsavory picture of the way the sled dogs were treated during the summer season. Although some of this ill treatment can still be seen, much of it has been relieved, especially in the villages. The dogs are now mostly kept tied up and fed, commonly by someone who is hired to do the job, so that they no longer have to forage for themselves. Seton's description of the dogs at Fort Resolution, however, was still true as late as

1927 when we camped there. They were still hunting in packs, and would tear through our camp, yapping and ravenous, in pursuit of anything that looked like food. It was never safe to leave anything edible unprotected even for a moment.

The title of the book should not go unnoticed, for in itself it has served a purpose and raised a problem. Seton did much to correct the mistaken concept of the "Barren Grounds" as they had been described by earlier travelers. He presented abundant evidence of their richness in animal life and vegetation. At the same time he called them "prairies" and thus linked them, tentatively at least, with the great interior grasslands of the continent. Whether he did so rightly or not is still an open question, for we do not yet know the historical and developmental relationships between the northern American prairies and the grass-sedge tundra of the Arctic. The solution to this problem is probably to be found in the Mackenzie basin, for there are natural grasslands scattered far northward through the boreal forests of that region.

The Arnold Arboretum
Jamaica Plain, Massachusetts

Hugh M. Raup

FIELD TRIPS OF THE CLUB

April 7, 1945. American Museum of Natural History. Our season opened with a study of displays in the Hall of Reptiles and Amphibians. Living pilot black snake, milk snake, raccoon, skunk, muskrat, and white rats were seen and handled by those interested. The group was told of the life habits of these animals. Leader, Mr. Robert Snedigar of the Museum Staff. Attendance 20.

April 14. Boyce Thompson Institute for Plant Research. As guests of the Institute, the group was conducted through the laboratories, greenhouses, library, and photography department. Dr. Albert Hartzell of the staff spoke at some length of his entomological work. The tour ended with the showing of a wodachrome lapse time movie of the growth and opening of a number of flowers, arranged through the courtesy of Dr. P. W. Zimmerman. Leader, Miss Myrtice A. Blatchley of the Institute Staff. Attendance 6.

April 15. Spring Lake, N. J. Forty-six bird species were recorded. "Among the waterfowl were seen Gadwall duck, Baldpate and Red-breasted Merganser. Excellent comparative views of Herring, Ring-billed, Bonaparte's and Laughing gulls, all in breeding plumage, were obtained at short range. An Osprey's nest was located. The mild spring had sent the waterfowl northward far ahead of schedule. In the afternoon, an exploratory trip for spring flowers was taken inland, in a westward direction from Spring Lake. No rarities located, but among the violets identified were: *V. sororia, V. sagittata,*

V. fimbriatula, V. lanceolata and *V. primulifolia.*" Leader, Mr. David Fables. Attendance 12.

April 22. New Jersey College for Women. Although the early spring made this a grand day for outdoors, our experiment with the laboratory study of a group, the lichens, was an obvious success. Carefully selected material, very able presentation, interested people, and ample equipment for individual work led all participants to call it a profitable experience. A few Chitrids and other forms were shown by Miss D. Fay. Leader, Mr. G. G. Nearing. Hostess, Miss Hettie Chute. Attendance 16.

PROCEEDINGS OF THE CLUB

Minutes of the Meeting of February 6, 1945

The meeting was called to order by President Seaver at 8:30 p.m. in Room 710 of Schermerhorn Extension, Columbia University. Thirty-eight members and friends were present. The minutes of the preceding meeting were approved as read.

The scientific program was presented by Dr. H. E. Warmke. His most interesting paper was entitled, "Studies on Localization of the Male Determining Gene in *Melandrium.*" The speaker's abstract follows:

In 2AXXY plants of *Melandrium dioicum,* the Y-chromosome is found to undergo frequent spontaneous breakage, and thus producing deficiencies of varying lengths. This breakage is believed related to asynapsis of the Y-chromosome, which is high in these stocks.

In 2AXXY plants gametes with large Y-deficiencies are functional because such deficiencies are "covered" by an accompanying X-chromosome. Since the Y-chromosome in this species is known to carry the major male genes, opportunity is thus afforded for studies of number, location, and effect of specific male-determining genes.

Evidence is now at hand for the presence of at least three distinct genes in the Y-chromosome of this species important in the development of maleness: one, which suppresses femaleness, is in or near the homologous segment; one, which initiates the male structures, is near the centromere; and one, which carries male development to completion, is near the end of the differential arm.

After considerable animated discussion the meeting was adjourned at 10:05 p.m.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of February 21, 1945

The meeting was called to order by President Seaver at 3:30 p.m. in Room 710 of Schermerhorn Extension, Columbia University. Twenty members and

friends were present. The minutes of the preceding meeting were read and approved. Eight annual members and two associate members were unanimously elected. The transfer of three annual members to associate membership was approved. The resignations of thirteen members were accepted with regret.

Dr. Seaver reported that the Auditing Committee had completed examination of the books, found them correct, and turned them over to the new Treasurer, Dr. Fulling.

The scientific program of the afternoon consisted of a paper by Dr. Lawrence P. Miller, entitled "Induced Formation of Glycosides in Plants." The speaker's abstract follows:

The addition to the nutrient medium of plants of organic chemicals which can serve as aglycons leads to the formation of β-glycosides in such plants. The ability of plants to form these β-glycosides seems to be very widespread and not correlated with the known occurrence or non-occurrence of natural β-glycosides in the species studied. Many of the species investigated were able to withstand the addition of relatively large amounts of chemical with the result that the β-glycosides formed became major constituents quantitatively of the tissues produced. The identity of the glycosides formed was established through isolation of the pure crystalline substances and comparison with the corresponding synthetic compounds which were especially synthesized in connection with these investigations. The type of β-glycoside formed depended upon the species, the particular plant organ involved and the chemical. Frequently the sugar component was not D-glucose. With solanaceous species some β-gentiobioside was always formed although gentiobiose is not known to occur normally in this family. In some instances in which the added chemical did not contain an hydroxyl group, other organic reactions had to take place within the plant prior to glycoside formation. It is suggested that studies of this nature are valuable in yielding information as to the type of organic reactions plants can carry out and as to the distribution or possible distribution of various sugars other than D-glucose in different species of plants.

After considerable discussion, the meeting was adjourned at 4:45 p.m.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of March 6, 1945

The meeting was called to order by President Seaver at 8:25 p.m. in Room 710 of Schermerhorn Extension, Columbia University. Twenty-seven members and friends were present. The minutes of the preceding meeting were approved as read.

Dr. Karling explained that Sigma Xi meeting would interfere with attendance of Columbia members on May 1 and suggested that the meeting be postponed until a later date. It was left to the program committee to arrange this.

The scientific program of the evening consisted of a lecture "The Pineapple Industry" by Ralph Holt Cheney. The speaker's abstract follows:

A brief monographic survey was given to the subject of the Pineapple and Man as the story of an economic plant in relation to human welfare. This golden fruit of the Guarani Indians of Brazil and Paraguay was welcomed so ardently by Europeans that the keen competition in its improvement by English and French hot-house growers during the 17th and 18th centuries, resulted not only in the development of more desirable strains of the pineapple, but also contributed a great deal to the technique of hot-house culture in general. There now exist several commercial varieties and thirty mutations are known. Mutations in the pineapple are occurring in asexually propagated varieties. These mutations are classified as regressive, progressive, dominant, and recessive. The mutation parade in pineapple agriculture suggests that mutations in these asexually propagated forms may cause a continuous and gradual change in the genotype so that ultimately a variety may develop genes not originally present and may lose some genes which were present. There is evidence that during asexual reproduction, there is an accumulation of recessive mutations in the germ plasm which may become evident in later sexual reproduction.

Several different botanical phases of the pineapple were summarized to illustrate the application of research in pure science to this economic plant. Experimental work was cited under the following categories:

1. Fruit morphology and its relation to the economic value.
2. Fruit phytochemistry (acids, vitamins, enzymes) in relation to its dietary significance.
3. Phycomycete and Fungi Imperfecti organisms in pineapple pathology.
4. Pineapple physiology and iron absorption by crown adventious roots.
5. Agricultural procedures including hormone stimulation of fruit formation and the commercial production (including by-products) as practised on the Hawaiian Islands of Oahu and Lanai was shown by kodachrome slides.

Discussion followed Dr. Cheney's paper. The meeting was adjourned at 9:20 and tea was served by Columbia ladies.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of March 21, 1945

The meeting was called to order by President Seaver at 3:40 p.m. in the Members Room at The New York Botanical Garden. There were twenty-four members and friends present. The minutes of the preceding meeting were approved as read. Fifteen annual members and four associate members were unanimously elected. The transfer of four annual members to associate membership was approved. The resignations of two members were accepted with regret.

Dr. Small read the following resolution:

Whereas, The Torrey Botanical Club has for over 75 years encouraged the study and

elucidation of the native plants and their distribution, particularly within a radius of 100 miles of New York City—the so-called Torrey Range—and

Whereas, the preservation of representative samples of native vegetation is essential to the continued study and teaching of floristics, and

Whereas, the area incorporated as the Borough of Island Beach represents a unique example of seashore vegetation, the only undisturbed and well developed area of this type of vegetation of any considerable size in New Jersey and the adjacent states,

Be it resolved: that the Torrey Botanical Club deplores the threat to transform this area into a public State Park of the type implied in recent specific proposals of the State Department of Economic Development.

And be it further resolved: that the Torrey Botanical Club urges that the Federal Government take over this area and administer it as a National Seashore through the National Park Service.

Dr. Small made the following motion:

I move the adoption of the above resolution, that it be spread upon the Minutes of the Club, that it be printed in TORREYA, and that copies of it be sent to the State of New Jersey Department of Economic Development, the Governor of New Jersey, Congressman Auchincloss, and the National Park Service.

It was seconded by Miss Hanson and carried unanimously.

The scientific program of the afternoon consisted of a very interesting illustrated discussion by Prof. John M. Fogg, "Studies on the Pennsylvania Flora." The speaker's abstract follows:

During the forty-two years which have elapsed since the appearance of Porter's "Flora of Pennsylvania," a real need has developed for a more recent and more comprehensive account of the plant life of the State.

With the objective of preparing such a treatment, a group of graduate students, under the direction of the speaker, has for the last ten years devoted serious effort to field work in many of the sixty-seven counties of Pennsylvania. Collections made as the result of a great many field trips have been supplemented by material in the Herbarium of the University of Pennsylvania, as well as by specimens housed in the Academy of Natural Sciences of Philadelphia, the State Museum in Harrisburg, the Carnegie Museum in Pittsburgh, and the Department of Botany at State College. All of these institutions have generously made their material available, so that it has been possible to examine well over 200,000 sheets and to incorporate the information which they contain into our records.

For the purpose of recording data, a special card, approximately 10 x 14 inches, and composed of 100 percent rag paper, has been selected. There is at least one such card for each of the approximately 2,500 species and varieties of vascular plants known to occur in the State. Each card has printed on it, in geographical sequence, the names of the counties, and on each card is recorded, by means of a flat-bed typewriter, the essential information contained on the collector's label, such as exact locality, collector's name and serial number, and a symbol indicating the herbarium in which the specimen is housed.

Accompanying each record card is another card of the same size and material, on which is printed an outline map of the State showing county divisions, principal rivers and streams, and lines indicating the extent of placiation, the front of the Appalachian Plateau, the line of the Blue Mountains and the Fall Line. The localities contained on the record card are then transferred to the outline map in the form of black dots, so that for each recorded locality there is a corresponding dot on the map. The entering of these dots

is done with the utmost care, and, although the scale of the dot itself is probably two miles in diameter, the center of the dot is located exactly at the spot where the plant was collected.

A preliminary survey of the flora of the State indicates that of the approximately 2,500 species which constitute its flora, some seven or eight hundred are introductions. Of the remaining number (seventeen or eighteen hundred), the overwhelming majority are of wide-spread occurrence, which, if not already collected in each of the sixty-seven counties, may eventually be expected to be found there.

Of greater interest to the student of plant geography are the several hundred species which are of more limited distribution. These fall into such groups as the following:

1) Northern or boreal species which may reach their southern limit of range within the State, or which, if they continue southward, occur only in the uplands of the Valley and Ridge Province or on the Appalachian Plateau. This group includes such species as *Clintonia borealis, Cornus canadensis, Oxalis montana, Trillium undulatum, Coptis groenlandica, Actaea rubra, Calla palustris,* and *Rhododendron canadense.*

2) Southern species which reach their northern limit of distribution within the State. Examples of this group are *Pinus pungens, Menziesia pilosa, Boltonia asteroides,* and *Marshallia grandiflora.*

3) Species of the Mississippi and Ohio Drainages, which occur only in the western counties, such as *Trillium nivale, T. sessile,* and *Quercus imbricaria.*

4) Plants of the Coastal Plain which appear only east of the Fall Line in Bucks, Philadelphia and Delaware Counties. To this category belong *Quercus phellos, Liquidambar Styraciflua,* and *Ilex opaca.*

In addition to these groupings, which reflect broad geographic distributions, many species owe their restricted occurrence to some particular soil preference or ecological requirement. Thus, *Asplenium cryptolepis* (*A. Ruta-muraria*), *Cheilanthes lanosa, Rhus canadensis,* and *Solidago squarrosa* which are marked calciphiles, are primarily restricted to outcrops of Cambro-Ordovician limestone; while *Talinum teretifolium, Cerastium arvense,* var. *villosum,* and *Aster depauperatus* occur only on the serpentine formations in the southeastern corner of the State. A number of maritime species, such as *Cakile edentula* and *Lathyrus maritimus,* are found only on the sandy shores of Lake Erie. A few shale barren species, such as *Senecio antennariifolius,* are restricted to barren slopes in Somerset, Bedford and Fulton Counties.

The primary objective of this work is the publication of a comprehensive account of the plant life of the State which shall be completely supplied with keys for identification and distributional maps. It is also planned to incorporate considerable information which will make the work useful to other than merely systematic botanists. For this reason an attempt will be made to interpret vagaries of distribution, where these are significant, and to include information drawn from such fields as ecology, cyto-taxonomy and genetics. The resulting volume should be of service to geologists, foresters, entomologists and teachers.

After discussion the meeting was adjourned at 4:45 for tea.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of April 3, 1945

The meeting was called to order by President Seaver at 8:20 p.m. in Room 710 Schermerhorn Extension of Columbia University. Forty-four members

and friends were present. The minutes of the preceding meeting were approved as read.

The scientific program of the evening was presented by Dr. George S. Avery, Jr., "Hormonal Aspects of Plant Life." The speaker's abstract follows:

The basic discoveries in plant science, such as photosynthesis, respiration, and mineral nutrition, all have to do directly or indirectly with growth. In addition, plants produce minute amounts of organic substances which are important in the regulation of growth. These internally produced growth-regulatory substances are generally referred to as hormones.

Hormonal aspects of plant growth have been studied 1) in terms of naturally occurring hormones, and 2) from results obtained from applying synthetic hormones in various types of carriers to plant tissue. Tumors and disturbed growth patterns often result from the application of various synthetic hormones.

A number of new horticultural practices have arisen from the theoretical work of the past ten years on plant hormones: abscission control, dormancy control, rooting of cuttings, seedless fruit production, selective weed killing, etc.

After much discussion from the audience, the meeting was adjourned at 9:10 p.m. for tea.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of April 18, 1945

The meeting was called to order by President Seaver at 3:30 p.m. in the Members Room of The New York Botanical Garden with twenty members and friends present The minutes of the preceding meeting were approved as read.

The secretary read the following letters:

I wish to acknowledge your letter of April 5 containing a resolution passed by the Torrey Botanical Club deploring the threat to transform the entire area of the Borough of Island Beach into a public state park and recommending that the Federal Government take this area over and administer it as a National Seashore through the National Park Service.

There is evidently some grave misunderstanding on the part of the Torrey Botanical Club as to the recommendations and objectives of the Economic Council in proposing that the State of New Jersey acquire the area of Island Beach.

Obviously, anyone who implies that the ten-mile area is all to become a public playground equivalent to five or six "Jones' Beaches" is misrepresenting our recommendation. Such an idea is too ridiculous on its face to require refutation. The resolution of the Economic Council was proposed by former Governor Edison and I am sure he has as great a desire as the Torrey Botanical Club to preserve the natural beauty of Island Beach. The recommendation sponsored by the Economic Council calls for the preservation of Island Beach in its natural state with its development as a State Park in

which due consideration would be taken of the need for public recreation areas as well as for the preservation of the remaining area in its natural state.

I resent the implication that the Federal Government through its National Park Service is better able to retain the beauties of a section of New Jersey than New Jersey herself. It was the feeling of Governor Edison and the other members of the Economic Council that New Jersey through its Department of Conservation should protect the natural resources of our State and not always turn with our hands out to the Federal Government.

(Signed) Charles R. Erdman, Jr., Com.
Dept. of Economic Development
State of New Jersey

I have your letter of April 5 enclosing a copy of resolutions recently passed by the Torrey Botanical Club in reference to the proposal to make a public park out of the Borough of Island Beach.

I appreciate very much your sending me your views on this important matter.

(Signed) James C. Auchincloss, M.C.
House of Representatives
Washington, D. C.

An announcement was made concerning the next meeting, which will be a supper meeting on Wednesday, May 2, at the Brooklyn Botanic Garden.

The scientific program of the evening was presented by Mr. Otto Degener, "Plant Life and Customs of the Hawaiian Islands." Mr. Degener's interesting remarks were illustrated with slides and movies.

The meeting was adjourned at 4:40 p.m. for tea.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

Minutes of the Meeting of May 2, 1945

After a picnic supper and a tour of the grounds of the Brooklyn Botanic Garden led by Dr. Svenson, the formal meeting was called to order by President Seaver at 8 o'clock. There were 31 members and friends present.

Three persons were unanimously elected to annual membership. The transfer of one annual member to associate membership was approved. The resignations of three members were accepted with regret.

The secretary read the following letter:

Thank you for your letter of April 5, informing us of the resolution passed on March 21 by the Torrey Botanical Club favoring the establishment of a national seashore to include the Island Beach property in New Jersey.

For a number of years the National Park Service has hoped that circumstances might permit the establishment of such an area. However, no funds are available to us for the purchase of the necessary land, and we are depending largely upon the local people and the State authorities to find ways and means of acquiring the property.

Mrs. Eleanor Marquand, Guernsey Hall, Princeton; Dr. George H. Schull, Princeton; and Mr. C. P. Wilber, State Forester and Director, Department of Conservation and Development, Trenton, are actively concerned with the problem at this time. If you have not already done so you may desire to obtain information from them as to their views in the matter. Any suggestions that your club, together with others concerned, might offer regarding means of advancing this important conservation proposal would be welcomed.

(Signed) Hillory A. Tolson, Acting Director
National Park Service
U. S. Dept. of the Interior

Dr. Small reported that a meeting of a committee of the persons mentioned above had already been called to consider the problem.

The scientific program of the evening consisted of two papers. Dr. H. K. Svenson spoke on the "Ecology of the New York area." His abstract follows:

The trip through the Local Flora Section of the Brooklyn Botanic Garden will be followed by a very brief account of the ecology of the New York region, to explain the areas represented by the plantings. These areas depend principally on geologic and climatic conditions. As represented in the Local Flora section they are: the Pine Barrens of New Jersey and Long Island; the Serpentine Barrens of Staten Island and eastern Pennsylvania; the limestone area of western New Jersey and eastern New York, and the crystalline granitic rocks of the Hudson Highlands; and the Hempstead Plains section of Long Island.

Represented are also such ecological units as a bog, a pond, a brook and a woodland—the plantations characterizing these units are also represented only by plants within the Torrey Club range.

Dr. George M. Reed spoke on the "Origin and Development of Flowering Cherries" and his abstract is as follows:

The oriental flowering cherries were largely developed in Japan and the history of their origin dates back approximately fifteen centuries. The starting point was the numerous wild cherry species growing in different parts of the Japanese Islands. The white northern mountain cherry and the red central and southern mountain cherry doubtless entered into the development of most of the varieties. As might be expected, there is great confusion in the nomenclature of the species. The cultivated forms were developed largely by the wealthy daimios and by the Buddhist Priests in the famous temples. Double varieties were secured many centuries ago. Probably the greatest development, however, occurred in the early years of the nineteenth century. How the improvements were brought about is not known.

The cherries are great favorites with the Japanese people and there are many famous places for viewing them. Some of the plantings date back for long periods of time, such as the ones along the Yoshino River near Kyoto, and at Koganei near Tokyo.

After discussion the meeting was adjourned.

Respectfully submitted,

Frances E. Wynne
Recording Secretary

THE TORREY BOTANICAL CLUB

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Mosses: E. B. Bartram, Frances E. Wynne
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OTHER PUBLICATIONS

OF THE

TORREY BOTANICAL CLUB

(1) BULLETIN

A journal devoted to general botany, established in 1870 and published bi-monthly at present. Vol. 71, published in 1944, contained 680 pages and 3 plates. Price $6.00 per annum. For Europe, $6.25.

In addition to papers giving the results of research, each issue contains the INDEX TO AMERICAN BOTANICAL LITERATURE—a very comprehensive bibliography of current publications in American botany. Many workers find this an extremely valuable feature of the BULLETIN.

Of former volumes, 24-71 can be supplied separately at $6.00 each; certain numbers of other volumes are available, but the entire stock of some numbers has been reserved for the completion of sets. Single copies ($1.00) will be furnished only when not breaking complete volumes.

(2) MEMOIRS

THE MEMOIRS, established 1889, are published at irregular intervals. Volumes 1-19 are now completed. Volume 17, containing Proceedings of the Semi-Centennial Anniversary of the Club, 490 pages, was issued in 1918, price $5.00.

Volume 19, no. 1, 92 pages, 1937, price $1.50. Volume 19, no. 2, 177 pages, 1938, price $2.00. Volume 19, no. 3, 76 pages, 1940, price $1.25. Volume 19, no. 4, 57 pages, 1941, price $1.00. Volume 19 complete, price $5.00.

Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

Reprinted monthly on cards, and furnished to subscribers at three cents a card.

Correspondence relating to the above publications should be addressed to

MISS ANNE M. HANSON
Department of Botany
Columbia University
New York 27, N. Y.

Volume 45 September 1945 Number 3

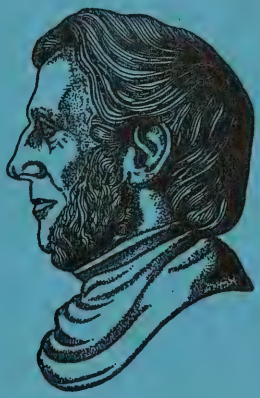
TORREYA

EDITED FOR

THE TORREY BOTANICAL CLUB

BY

HAROLD H. CLUM



John Torrey, 1796-1873

CONTENTS

Early Flowering of Plants in 1945 ..... Robert T. Clausen 65

Monarda fistulosa L. and its Two White-Flowered Forms ..... Earl Edward Sherff 68

The Taxonomy of the Genus Krukoviella A. C. Smith (Ochnaceae) ..... John D. Dwyer 69

A Botanist Leaves Hawaii ..... Otto Degener 72

A Contribution to our Knowledge of the Wild and Cultivated Flora of Maryland—I ..... Harold N. Moldenke 79

Kennedy and Heller (1905-1913) ..... Alan A. Beetle 93

Report on Bomb Damage to Botanical Material in England 96

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All persons interested in botany are invited to join the Club. There are four classes of membership: *Annual,* at $5.00 a year; *Associate,* at $2.00 a year; *Sustaining,* at $15.00 a year; and *Life,* at $100.00. The privileges of all except *Associate* members are to attend all meetings of the Club, to take part in its business, and to receive all current publications, except the *Memoirs* which are sold to members at cost. *Associate* members have the privilege of attending all meetings and field trips. They also receive the *Schedule of Field Trips* and the *Bulletin* of the New York Academy of Sciences. Applications for membership should be addressed to the Treasurer.

TORREYA

Torreya was established in 1901 as a monthly publication of the **Torrey Botanical Club** for shorter papers and interesting notes on the local flora range of the Club. It also contains the proceedings of the Club, reports of field trips, and some book reviews and news notes. The current volume will be issued in four numbers.

The editor invites contributions for future numbers of Torreya. These should be typed with double spacing on one side of standard paper. Illustrations should be mounted on stiff cardboard, with the desired reductions plainly indicated, and so designed as to fill the full width of the page (4⅝ inches) and any portion of the height (7⅛ inches). Legends for illustrations should be typed and included with the manuscript (*not* affixed to the figures).

The subscription price of Torreya in the United States and Canada is $1.00 a year, for subscribers elsewhere, 25c extra; single copies, 40c. Of the annual membership dues of the **Torrey Botanical Club,** $0.50 is for a year's subscription to Torreya.

Claims for missing numbers should be made within sixty days from the date of mailing.

Subscriptions and requests for back numbers should be addressed to the Business Manager, Miss Anne M. Hanson, Department of Botany, Columbia University, New York 27, N. Y.

Manuscripts for publication, books for review, reports of field trips, and news items should be addressed to:

Harold H. Clum
Hunter College, 695 Park Avenue
New York 21, N. Y.

TORREYA

VOL. 45 SEPTEMBER 1945 NO. 3

Early Flowering of Plants in 1945

ROBERT T. CLAUSEN

March and April, 1945, were remarkable in the northeastern United States for the prolonged period of warm weather. The high temperatures which broke meteorological records provided conditions which caused many species of plants to flower far ahead of their usual time. In the last few seasons, the writer has been interested to keep records of the first dates of flowering for the vicinity of Ithaca, New York. Shedding of pollen has been the criterion used for considering a plant to be in flower. Aided by colleagues and students in his course in taxonomy, the writer has made an attempt to find all native or naturalized species which might be in flower up to May 1. Comparison of the results for 1945 with the two seasons preceding is interesting. A similar survey in 1943 revealed 45 species in bloom before May 1; in 1944, 50 species were recorded; but in 1945, the list stood at 209. This surpasses by 90 species the report by Professor Fernald (Rhodora **12:** 127-129. 1910) of 119 species in flower in eastern Massachusetts in April, 1910. The list for the Ithaca region for 1945 is reproduced below with the earliest date when each species was found with ripe pollen. In a few cases, the first bloom was found on a cultivated specimen of a wild plant from a local source. These records are indicated by a "C" after the name. All records, unless otherwise noted, are from the vicinity of Ithaca, in Tompkins County, New York. A=April; M=March.

EQUISETUM ARVENSE—A 1
EQUISETUM HYEMALE var. AFFINE—A 1
EQUISETUM SYLVATICUM—A 29
EQUISETUM VARIEGATUM—A 17
LYCOPODIUM OBSCURUM—M 25
OSMUNDA CLAYTONIANA—A 29
TAXUS BACCATA subsp. CANADENSIS—A 8
ACTAEA RUBRA—A 17
ANEMONE QUINQUEFOLIA—A 8
ANEMONELLA THALICTROIDES—M 30
CALTHA PALUSTRIS—A 1
COPTIS TRIFOLIA subsp. GROENLANDICA—A 14
HEPATICA ACUTILOBA—M 25
HEPATICA AMERICANA—A 1
HYDRASTIS CANADENSIS C—A 15
RANUNCULUS ABORTIVUS—A 9
RANUNCULUS HISPIDUS—A 8
RANUNCULUS SEPTENDRIONALIS—A 24
THALICTRUM DIOICUM—A 9
TROLLIUS LAXUS—A 8
BERBERIS THUNBERGII—A 12
BERBERIS VULGARIS—A 24
CAULOPHYLLUM THALICTROIDES—A 3
JEFFERSONIA DIPHYLLA C—A 7
LINDERA BENZOIN—A 1
SASSAFRAS ALBIDUM C—A 12
POPULUS BALSAMIFERA—M 29
POPULUS GRANDIDENTATA—A 1
POPULUS TREMULOIDES—M 18
SALIX ALBA—A 17

TORREYA for September (Vol. 45, 65-96) was issued September 28, 1945.

Salix Bebbiana—A 1
Salix cordata—A 1
Salix discolor—M 28
Salix fragilis—A 4
Salix humilis—A 1
Malva neglecta—A 12
Ulmus americana—M 23
Ulmus fulva—A 12 (in fruit)
Geranium maculatum—A 17
Oxalis stricta—M 29
Zanthoxylum americanum C—A 12
Polygala paucifolia—A 17
Euphorbia Cyparissias C—A 12
Viola arvensis—A 13 (Cortland County)
Viola blanda—A 15
Viola canadensis—A 15
Viola conspersa—A 1
Viola cucullata—A 15
Viola fimbriatula—A 29
Viola incognita—A 15
Viola odorata—M 28
Viola pallens—A 1
Viola palmata—A 24
Viola pensylvanica—A 8
Viola pubescens—A 15
Viola renifolia—A 15
Viola rostrata—A 14
Viola rotundifolia—A 15
Viola Selkirkii—A 15
Viola septentrionalis—A 15
Viola sororia—A 1
Viola striata—A 17
Chelidonium majus—A 13
Sanguinaria canadensis—M 29
Dicentra canadensis—A 17
Dicentra Cucullaria—A 3
Barbarea vulgaris—A 10
Capsella Bursa-pastoris—M 27
Cardamine bulbosa—A 8
Cardamine pensylvanica—A 15
Cardamine pratensis—A 13
Dentaria diphylla—A 14
Dentaria laciniata—A 3
Draba verna—M 17
Hesperis matronalis—A 24
Lepidium campestre—A 24
Thlaspi arvense—A 25
Arenaria serpyllifolia—A 24
Cerastium vulgatum—A 7
Stellaria media—M 13
Stellaria pubera—A 29
Claytonia caroliniana—A 3
Claytonia virginica—A 3
Rumex Acetosella—A 13
Epigaea repens—A 1
Rhododendron nudiflorum—A 22
Vaccinium angustifolium—A 1
Vaccinium corymbosum—A 29
Fraxinus pennsylvanica—A 7
Phlox divaricata—A 24
Phlox subulata—A 8
Lithospermum arvense—A 12
Mertensia virginica C—A 6
Myosotis sylvatica—A 16
Pedicularis canadensis—A 17
Lamium amplexicaule—A 14
Lamium purpureum—A 6
Nepeta hederacea—A 9
Veronica arvensis—A 7
Veronica didyma—M 15
Veronica filiformis C—A 12
Veronica peregrina—A 7
Veronica serpyllifolia—A 7
Amelanchier arborea—A 8
Amelanchier intermedia—A 15
Amelanchier laevis—A 3
Amelanchier sanguinea—A 29
Crataegus filipes—A 21
Crataegus macrosperma—A 24
Crataegus pruinosa—A 24
Duchesnea indica—A 24
Fragaria vesca—A 15
Fragaria virginiana—A 1
Prunus americana—A 22
Prunus avium—A 9
Prunus domestica—A 15
Prunus pennsylvanica—A 15
Prunus virginiana—A 14
Pyrus communis—A 11
Pyrus Malus—A 12
Rubus pubescens—A 22
Waldsteinia fragarioides—A 15
Chrysosplenium americanum—A 1
Mitella diphylla—A 15
Ribes americanum C—A 12
Ribes Cynosbati—A 15
Ribes hirtellum C—A 12
Ribes odoratum C—A 12
Ribes sativum—A 15
Ribes triste—A 8

Saxifraga virginiensis—A 8
Tiarella cordifolia—A 15
Medicago lupulina—A 5
Trifolium repens—A 13
Vicia caroliniana—A 17
Asarum canadense—A 3
Staphylea trifolia C—A 12
Daphne Mezereum—M 27
Dirca palustris—A 1
Shepherdia canadensis C—A 7
Comandra umbellata—A 29
Acer Negundo—M 29
Acer pennsylvanicum—A 24
Acer rubrum—M 27
Acer saccharinum—M 15
Acer saccharum—A 1
Rhus aromatica—A 1
Quercus alba—A 24
Alnus incana—M 18
Alnus rugosa—M 18
Betula papyrifera C—A 12
Betula populifolia—A 1
Carpinus caroliniana—A 15
Corylus cornuta—M 18
Ostrya virginiana—A 9
Myrica peregrina C—A 12
Panax trifolium—A 15
Zizia aurea—A 16
Galium aparine—A 24
Houstonia caerulea—A 15
Lonicera canadensis—A 1
Lonicera tatarica—A 13
Sambucus racemosa subsp. pubens—A 12
Viburnum alnifolium—A 14
Antennaria canadensis—A 15
Antennaria fallax—A 28
Antennaria neglecta—A 15
Antennaria neodioica—A 14
Antennaria Plantaginifolia—A 8
Bellis perennis—M 14
Senecio aureus—A 29
Senecio vulgaris—M 30
Taraxacum officinale—M 14
Tussilago Farfara—M 18
Erythronium americanum—M 30
Polygonatum pubescens—A 17
Trillium erectum—A 3
Trillium grandiflorum—A 3
Trillium undulatum—A 29
Uvularia grandiflora—A 17
Uvularia perfoliata—A 24
Uvularia sessilifolia—A 14
Luzula acuminata—A 1
Luzula campestris—A 24
Arisaema triphyllum—A 3
Symplocarpus foetidus—M 14
Carex anceps—A 22
Carex arctata—A 15
Carex artitecta—A 17
Carex blanda—A 17
Carex bromoides—A 29
Carex communis—A 1
Carex Deweyana—A 29
Carex hirtifolia—A 17
Carex laxiculmis—A 15
Carex pedunculata—A 1
Carex pennsylvanica—A 1
Carex plantaginea—A 1
Carex platyphylla—A 3
Carex prasina—A 29
Carex scabrata—A 29
Carex stipata—A 24
Carex umbellata—A 1
Alopecurus pratensis—A 14
Oryzopsis asperifolia—A 15
Poa annua—M 20
Poa pratensis—A 13
Hypoxis hirsuta C—A 15
Cypripedium parviflorum C—A 27

The writer is grateful to all those who contributed specimens and reports for the above list.

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Monarda fistulosa L. and Its Two White-Flowered Forms

Earl Edward Sherff

Monarda fistulosa typica var. nov.; *M. fistulosa* L. Sp. Pl. 1:22. 1753, *sensu stricto.*

Monarda fistulosa var. **mollis** f. **albiflora** (Farw.) comb. nov.; *M. mollis* f. *albiflora* Farw. Papers Mich. Acad. Sc. Arts & Letters **3:** 103, 1923.

"Gray's New Manual of Botany" (7th ed. 704. 1908) retained *M. fistulosa* L. and *M. mollis* L. as separate species, but both before and since the publication of that work, various careful workers have chosen to treat *mollis* as a mere variety of *M. fistulosa.** Recently, Fernald, the surviving, junior editor of "Gray's Manual" (7th edition), has reviewed the taxonomy of *M. fistulosa* and has accepted varietal rank for the *mollis* group. He seems to have omitted all notice of the interesting white-flowered forms that both *M. fistulosa* var. *typica* and *M. fistulosa* var. *mollis* have been reported by Farwell to produce. Besides the f. *albiflora* mentioned above, Farwell described (Amer. Midl. Nat. **8:** 276. 1923) a forma *albescens* for *M. fistulosa.* For greater precision, this forma may be known as *M. fistulosa* var. *typica* f. *albescens* Farw.

Farwell cited his own no. *6650* for f. *albescens,* collected at Metamora, southeastern Michigan, July 18, 1923. The present writer found, and repeatedly observed over a period of several weeks, a small patch of typical f. *albescens* in the summer and early autumn of 1944. It was growing just south of Hastings, Michigan, on a shaded embankment along the South Broadway Road. This locality is somewhat more than 100 miles west-southwest of the type locality. Flowering heads were numerous and all florets were a pure white, with no transitions to the lavender or other shades of blue found customarily in var. *typica.* Moreover, a careful subsequent study of preserved material (now deposited in herb. Chicago Nat. Hist. Mus. etc.) showed beyond all doubt that it was to be construed as belonging under *M. fistulosa* (var. *typica*) and not under the allied, normally white-flowered *M. clinopodia* L.

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* Indeed, McClintock and Epling (Univ. Calif. Publs. Bot. **20:** 165. 1942), even equate the two, although this seems to me unwarranted.

The Taxonomy of the Genus Krukoviella A. C. Smith (Ochnaceae)

John D. Dwyer

The history of the genus *Krukoviella* A. C. Smith, while recent, is rather complex. In 1904 van Tieghem (Ann. Sci. Nat. Paris VIII, **19:** 39) published the genus *Planchonella* with one species *P. disticha* in his family Luxembourgiacées. Obviously he was unaware that his genus was a homonyn of the earlier *Planchonella* Pierre of the Sapotaceae (Notes Botaniques Sapotacées 1-36. 1890). Ule in 1915 (Notizbl. Bot. Gart. Berlin **6:** 340) made a new combination of van Tieghem's species *Godoya disticha* (van Tieghem) Ule. A. C. Smith without reference to any of this earlier work published the genus *Krukoviella* (Jour. Arnold Arb. **20:** 295. 1939) with one species *K. scandens*. Thus *Krukoviella* A. C. Smith takes precedence over the invalid homonym *Planchonella* van Tieghem, the type species of *Krukoviella* being *Planchonella disticha* van Tieghem. In this paper I have made the new combination: *Krukoviella disticha* (van Tieghem) Dwyer.[1]

While the nomenclatural history of *Krukoviella* is complex, its phylogenetic position is relatively simple. Its relationship with several tropical American genera of the tribe Luxemburgieae: *Godoya* R. and P., *Cespedezia* Goudot, and *Rhytidanthera* van Tieghem, is evident, being manifest especially in its foliar bracts which bear basal glandular appendages on the inside. In contrast to this complex of genera *Krukoviella* lacks similar appendages on the inner face of the sepals, a condition furnishing an excellent generic character. Its close relationship with *Godoya* R. and P. is shown principally in the morphology, venation, and texture of the leaf-blades, in the texture and shape of the sepals, and in the dehiscence of the anthers by a single instead of by two terminal pores. While A. C. Smith gives an excellent discussion of the genus I must disagree with his statement that *Krukoviella* differs from the remaining genera of the tribe in the character of its stigmas. Although dissections of immature pistils of *Cespedezia, Godoya,* and *Rhytidanthera* show them to have little stigmatic differentiation, mature material reveals that these genera possess definite sessile radiating stigmas similar to those of *Krukoviella*. Likewise I cannot agree with Smith's statement that *Krukoviella* differs from *Godoya* in that the stamens are disposed about the pistil in one row rather than two. Observations have revealed that both genera have their stamens arranged in a

[1] This paper was submitted as part of a thesis on the *American Genera of the Tribe Luxemburgieae* (*Ochnaceae*), in partial fulfillment of the requirements for the degree of Doctor of Philosophy, Biological Laboratories, Fordham University Graduate School, New York, N. Y.

single whorl. In a recent paper (Bull. Torrey Bot. Club **71:** 175-178. 1944) I have discussed the morphological characters linking up the majority of the genera of the Luxemburgieae, including the genus *Krukoviella.*

Specimens examined for this paper are deposited in the herbaria of the following institutions:

Field Museum of Natural History, Chicago, Ill. .....(F)
Gray Herbarium, Cambridge, Mass. .....(G)
Royal Botanical Garden, Kew Gardens, England .....(K)
The New York Botanical Garden, New York, N. Y. ...(NY)

I wish to thank Mr. Charles Gilly who made the excellent figure of *Krukoviella* (Fig. 1).

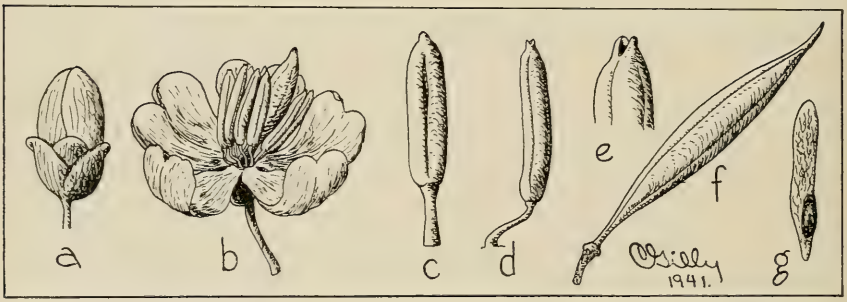

FIGURE 1. KRUKOVIELLA A. C. Smith. *K. disticha* (van Tieghem) Dwyer: a—bud (x 2); b—flower (x 1.5); c—stamen, dorsal view (x 4); d—stamen, lateral view (x 4); e—apical portion of stamen, showing the solitary terminal dehiscence pore (x 8); f—capsule (x 1); g—seed (x 5). (a—e, drawn from *Krukoff 8908;* f and g, drawn from *Williams 5988*).

KRUKOVIELLA A. C. Smith, Jour. Arnold Arb. **20:** 295. 1939.

Planchonella van Tieghem, Ann. Sci. Nat. Paris VIII. **19:** 39. 1904, not *Planchonella* of Pierre, Not. Bot. Paris p. 34. 1890.

Godoya Ule, Notizbl. Bot. Gart. Berlin **6:** 340. 1915, not *Godoya* of R. and P. Fl. Per. Prodr. **1:** 58. 1794.

Shrubs (or vines?); lenticels evanescent; stipule-scars distinct, the stipules appressed, coriaceous, bearing glandular appendages on the inner proximal margin; petioles of leaves short, the leaf-blades simple, ascending, the margin revolute, the teeth minute, the costa prominent above and below, the secondary veins conspicuous and subplane; inflorescence paniculate, the rachis elongate, pluriramose; flower pedicellate, the articulation-stalk short; sepals 5, subequal, coriaceous, persistent; petals 5, exceeding sepals in length, obtuse, often bilobed at apex; stamens 10, the filaments short, the anthers stout, linear-oblong, de-

hiscing by a single terminal pore; pistils solitary, 5-carpellate, crassate, the ovaries oblong, constricted above into a very short style, the stigmas 5, terminal, radial, and sessile, the ovules imbricate in several rows on 5 intrusive T-shaped parietal placentae; fruit (apparently) capsular, fusiform-falcate, the seeds short-winged.

Type Species: *Planchonella disticha* van Tieghem.

Krukoviella disticha (van Tieghem) Dwyer, comb. nov.

Planchonella disticha van Tieghem, Ann. Sci. Nat. VIII. **9:** 39. 1904.

Not *Planchonella* of Pierre Not. Bot. Paris p. 34. 1890.

Godoya disticha (van Tieghem) Ule, Notizbl. Bot. Gart. Berlin **6:** 340. 1915.

Krukoviella scandens A. C. Smith, Jour. Arnold Arb. **20:** 296. 1939.

Shrubs (or vines?); stipule scars distinctly transverse, about 2-10 mm. apart; stipules appressed or contorted, thin-coriaceous, minutely glandular-strigose, rectangular, about 8 mm. long, about 4 mm. wide, distinctly rotund at apex, the margin entire, the corpus bearing small glandular appendages on inner proximal margin; petioles of leaves glabrous, 4-6 mm. long; leaf-blades subascending, glabrous, lustrous, thin-coriaceous, obovate or oblong, 4-16 cm. long, 2-8 cm. wide, obtuse at apex, cuneate or tapering obtusely at base, the costa prominent above, strongly prominent beneath, 0.15-0.2 cm. wide at base, tapering toward apex of blade, the secondary veins 9-18, conspicuous, subplane, 0.4-1.2 cm. apart in middle of lamina, spreading from costa at about a 70°-75° angle, the tertiary veins conspicuous and forming a conspicuous reticulum, the margins often strongly revolute, the teeth appressed, lanceolate, 0.25-0.5 mm. long, 1-6 mm. apart; inflorescence a dense terminal panicle, the flowers in bostryces, usually 3 per bostryx, the rachis 6-17 cm. long, exceeding uppermost leaves, the basal branches 6-12 cm. long, 1.8-3.5 cm. apart, becoming shorter and more dense at apex, the smaller branches compressed-paniculate, the articulation stalks 0.1-0.3 cm. long, the pedicels slender, 0.7-1 cm. long at anthesis; sepals subequal, coriaceous, glabrous, concave, ovate, ovate-rotund or ovate-oblong, less than half the length of petals, the outer 3-4 mm. long, 2.3-3 mm. wide, the inner 3.4-5.3 mm. long, 3-4 mm. wide, rotund at apex, obtuse or vaguely auriculate at base, the margin entire, without glandular appendages on inner proximal margin; petals yellow, carnose, obovate or obdeltoid, 9-13 mm. long, 6-8 mm. wide, obtuse at apex, frequently bilobed, the sinus up to 5 mm. deep, or erose-marginate or entire at apex, distinctly obtuse or tapering narrowly (often 1 mm. wide) at base; filaments of stamens slender, about ⅓ length of anthers, the anthers stout, lustrous, smooth, linear-oblong, 4-5.5 mm. long, dehiscing by a solitary terminal pore, obtuse-cuspidate at apex, vaguely auriculate at base; ovaries crassate, verrucose or thickly striate, narrow-oblong, 7.5-9 mm. long, 2-2.5 mm. wide, constricted above into

a short style, the latter less than 0.5 mm. long, the stigmas 5, usually distinct, white, radiating, sessile, oblique; fruit erect or vaguely falcate (dehiscent material not seen), linear-fusiform, up to 3 mm. long (here), acute at apex, the seeds short-transparent-winged, the wing (here) about 3 mm. long at one end (Fig. 1, a-g).

Type Locality: Mt. Guayrapurina, Tarapoto, San Martin, Peru.

Distribution: Known from the States of San Martin and Loreto, Peru, and the State of Amazonas, Brazil.

Peru: San Martin: Tarapoto, *Spruce 4003* (F, photo., G,K, type collections of *Planchonella disticha*); Loreto: *Williams 5988* (F); Serro de Isco, *Ule 6716* (F, photo. and frag.). Brazil: Amazonas: São Paulo de Olivenca, *Krukoff 8908* (F, NY, type collection of *Krukoviella scandens*).

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A Botanist Leaves Hawaii*

Otto Degener

The speaker, Collaborator in Hawaiian Botany at the New York Botanical Garden and resident of Hawaii since 1922, was feeding his tame pigeons on the lawn of his country home on Oahu one memorable December 7th morn when a score of planes roared overhead. As the peaceful pigeons were interested in the grain he held, and he was interested in the cooing and pirouetting pigeons, both parties ignored the noisy mechanical fliers. It was only hours later, after he tuned in on his radio and heard the frantic appeals for Dr. So-and-so, Dr. This and Dr. That—down the entire medical registry from A to Z—to report at the nearest hospital for disaster work that he realized something out of the ordinary had transpired. His 13-year old Hawaiian protege, who had bicycled to the village three miles away, on his return excitedly related how the occupant of a plane had shot at him and that a jump into a sugar cane tangle had saved him from harm, and how the shingle roof of his uncle's and *tutu's* house in the village had been riddled with bullet holes.

The radio blared for doctors; then with a minister's saintly voice, filled with anguish, it began to admonish and sooth the populace with Christ's

* Mr. Degener talked to the Torrey Botanical Club on April 18, 1945, on "Plant Life and Customs of the Hawaiian Islands." (Torreya **45**: 63. 1945.) When asked for an abstract of his talk he gave us this interesting account of how he happens to be in the Continental United States, which serves as an introduction to his abstract.

prayer "Father forgive them; for they know not what" . . . . but was cut off the air abruptly; next it blared for more doctors; it ordered every one, except employees at the electric power plant, to remain indoors at home; it reproduced the familiar voice, now uncannily serious and sometimes broken, of his friend and former lawyer, Governor Poindexter, delivering a proclamation; and it warned all to keep their radios tuned for further instructions. The beach and roads swarmed with soldiers rushing about like a hill of disturbed ants. Civilian cars were halted with threat of bayonet, and turned back to their garages. The black-out at night was complete, with soldiers shooting from outside through the window panes at any light bulb left burning by some distraught or absent-minded civilian. Cigaret smoking was *kapu,* or taboo. The speaker not only unscrewed the light fuses but also turned off the electric switch for his entire house lest his 20-year old Hawaiian servant, paroled to him from the home for feeble-minded, might thoughtlessly light a light. Yet with all this man-made darkness, a volcano on the Island of Hawaii treacherously tried to aid the enemy by bursting out into a stream of red hot lava visible for hundreds of miles at sea.

The night of December 7, 1941, the speaker, the dull *kanaka* servant, the wide-awake protege, the all-hearing dog, watched the magnificent Fourth of July spectacle of powerful searchlights sweeping over the ocean with hazy beams in search of possible enemy landing parties. As a wave heaved and heaved upward, it was darkly visible; when it broke into an ever-enlarging glare of combers with bubbles, fine foam and spray, it was a dumbfounding sight to watch, while its reflection lit up the sky. The three human beings, all the while with cold fear gnawing at their hearts, were fascinated by the pitch blackness rhythmically followed by searchlight-swept spume. The dog, devoid of appreciation for this beautiful dramatic sight, was all ears. He was restlessly belligerent and noisily barked whenever he heard the unfamiliar footsteps and commands of soldiers in the garden, *his* garden whose every shrub and tree he knew and had personally blazed as his own property. Though Life and Death might be hanging imminently in the balance, the three human beings were helpless. Either nothing unusual would happen or an invading party might appear over the crests of the waves during the night and easily enough send them, with a few excruciating bayonet jabs, botanizing asclepiads along the Milky Way. The three, tired after a hectic day, lay down in vain to sleep; the dog, beside his master's couch, intermittently growling in stubborn defiance whenever footsteps crunched in the sandy garden.

Though the tropic night was comfortably warm, the inner side of the speaker's thighs started their paroxysms of trembling, trembling like the muscle of a horse that tries to dislodge a fly where neither weary head nor

docked tail can reach it; a trembling that had been forgotten since those early childhood nightmares when the visionary, painted Indian, with tomahawk raised aloft, was sneaking up nearer and nearer and ever yet nearer to one's once curly golden locks. Philosophical thoughts gradually reduced the frequency and intensity of the fitful trembling until from fifteen miles away, from the direction of Schofield Barracks, came a dull booming followed almost immediately by a crackling crunching crash. This booming and crash was thrice repeated. Stillness, only broken by the familiar swishing of the searchlight-brightened surf, followed. Renewed paroxysms of trembling came even though the speaker had not learned that the explosions and the immediate falling of crumbling masonry had heralded the return of enemy bombers to Schofield and signified the cruel mangling of hundreds of weary soldiers in the burning, twisted wreckage. Finally came the deep sleep of a fatigued soul and of an exhausted body bathed in cold sweat.

In the bright sunshine friendly but grim soldiers hailing from all regions of the Continental United States stood guard along the beach, dug trenches, erected barbed-wire entanglements, etc. One could tell their places of origin by their dialect: brawny hill-billies with Southern drawls; pale counting house clerks with broad "Hairvard" and "Airnold Airboretum" A's; clothiers with Bronx cheers; taxi drivers with Irish brogue; bow-legged Texans, with lady-like feet, conspicuously laconic; sun-tanned Californian orchardists jealously loquacious about Hawaii's "liquid sunshine"—Americans all.

We *kamaainas* or old timers in Hawaii of all possible racial backgrounds, felt closely knit together, with our homes and interests in immediate jeopardy. Special *aloha* was shown by many toward their *nisei* friends, *nisei* acquaintances and the *nisei* strangers within our islands. Conversely, these deeply dejected Americans of Japanese ancestry were particularly eager to show their unfailing loyalty to America and to show their unutterable shock at the dastardly acts of the war lords of their parent's fatherland. It was no surprise to people long resident in Hawaii and familiar with the *nisei,* when the military authorities recently proclaimed that not one act of sabotage had been committed by an Hawaiian *nisei* since Pearl Harbor. Moreover, many had fought valiantly and had died for their country on the battlefields of Europe and elsewhere.

The colonel coming to the house frankly stated that if the Japanese fleet, now not far distant, should loom over the horizon, his tanks would run parallel with the beach to butt and run down each and every house in the community. Occupants would be granted one hour to evacute their belongings. This destruction was necessary so that enemy gunners stationed on nipponese warships could not so easily sight over a certain house, as a conspicuous landmark, to the flash of our defending guns concealed in the

neighboring forehills. A strip of barren beach would give the enemy less aid in sighting their targets.

A few days were spent by the speaker and his companions digging a large hole in the sand under a clump of towering casuarinas. With the aid of an old piano box and many sand-filled burlap bags it formed a tolerable air-raid shelter. The soldiers began digging their very elaborate burrows at about the same time, unearthing in the neighboring lot a human skeleton. It was in a remarkable state of preservation due, no doubt, to the sea sand, in which the corpse had been interred, consisting of almost 100% bone—"bone" of coral, mollusk, echinoderm, fish and coralline algae. The man had died after the death of a loved one or of his chief as the absence of his two upper front teeth proved. In case of mourning, the Hawaiian formerly inserted a wedge between his two front teeth, gave it a sharp blow with a stone; knocked the wedge in twice toward the gum on the other side of both teeth and then extracted the loosened incisors as a token of grief.

In the beach house were almost twenty years' accumulation of Hawaiian herbarium specimens, the Philippine and Bornean collection of ferns purchased and received by bequest from the late D. LeRoy Topping, and much of the Anne Archbold—"Chêng Ho" collection of Fiji specimens including a new family or two. These plants to the speaker were almost as precious as life itself; to many others, far more precious. They had to be rescued from possible destruction.

The islands had been hard hit, harder than we liked to confess. Transportation to Honolulu and storage, for unappreciated dry plants when food and munitions needed transfer and housing, were not available. Days were spent removing excess newspaper from between duplicate herbarium specimens, packing the entire collection, and mailing it by insured parcel post to The New York Botanical Garden. Days were spent in interring in caves or other secret places family heirlooms, silverware, botanical source books like "Engler-Prantl" and the *Index Kewensis,* compound microscope, and other material too valuable to abandon to the enemy or to leave unprotected in a vacated house. As the gravid ceiling proved, the attic had been groaning for several years with unsold copies of Books 3 and 4 of the speaker's *"Flora Hawaiiensis"* or "New Illustrated Flora of the Hawaiian Islands." Considering the emergency it was judged wisest to evacuate all but about 250 copies of each of these two Books. The speaker therefore wrote to the main library in Honolulu for the loan of a library directory. As none was forthcoming, he consulted an old gazetteer listing all communities in the United States. Then the wrapping of Floras began in earnest, one book per package.

Quite safe in assuming that a community with a population of 5,000 or over boasted some kind of library, the speaker mailed one book to the public library of the first community of proper size listed in the gazetteer; he

mailed another to the next public library. He continued this procedure until all excess books were gone. He felt it better for his ego and for posterity to give away the greater part of his editions than to risk their complete oblivion by a well directed Japanese bomb. It was a tremendous task, particularly wrapping books by touch in a totally darkened house at night, with only the faint intermittent glare of the searchlights as they swept in long beams across the waves. With each book went an explanatory postal, more than hinting that four other profusely illustrated books written by the speaker were available at the regular, very reasonable price. Auto loads of plants and books left the beach house for the neighboring village post office, and the sale of stamps was large enough to raise the post office to a higher category of classification.

While this evacuation of botanical assets was proceeding, the speaker estimated that the first part of his task would be completed by February 1st. The next was to write the thousands of labels for the plants mailed to New York so that in the event of his eventual death, later workers could use the herbarium to full advantage. He therefore wrote the clipper company to reserve passage for two for the flight to California any day after February 1. The reply instructed him to be in Honolulu with his protege from that date on. As the clipper left for California at an undisclosed time and passengers received but one hour's notice of its departure, they had to be near the air field in Honolulu. If they missed the call for passage, they were placed at the very end of the list of reservations.

February 1st the speaker removed to his Honolulu house with his Hawaiian protege. It had been recently vacated by his tenant, an army officer, and the only furniture remaining was a Steinway concert grand piano, a white elephant, that would deteriorate if kept in the salt air of the beach house. The speaker borrowed two light mattresses, a porch table and two chairs from neighbors until clipper time should arrive, preparing to "camp" in the house with his protege in the meantime.

The amount of mail delivered to the Honolulu house twice daily increased like the bulk of a snowball rolling down hill. Besides letters of thanks from librarians, many with most interesting observations about the war; cash orders streamed in for the volumes not represented in the sample shipment. Such orders received immediate attention. Then out of a clear sky, like a bomb, the printer of his book on "Plants of Hawaii National Park," brought the unsold copies of that nontechnical work to his door with the announcement that the warehouse was needed by the government.

During all this time alerts and air-raid warnings were almost daily occurrences—often twice daily—and, after a while, the speaker simply filled his bath-tub with water and placed the mop inside as a possible fire-fighting weapon. Work was little interrupted as the botanical show must go on. An

entire block in the Moiliili District of Honolulu, a district mostly inhabited by Japanese, was a shambles due to enemy bombing. Eye-witness accounts by friends and by friends of friends hitherto always reliable, passed the rounds as well as idle rumors: how the enemy fliers flew low to slice off with their whirling propellers the head of any one so unfortunate as to be caught stranded on our air-fields; how exhausted one physician was from holding leg after leg during amputations, and the sudden great weight of the human leg as the knife has cut it clean from the body; how nauseated a surgeon's faithful wife became when she had to clean the clotted blood from his clothes and white tennis shoes after he returned dead tired in the early morning hours from the hospital; of the many instances of heroism by individuals; and, by the ignoring of unmistakable warnings, of the sale of Hawaii down the river by politicians in their effort to rouse the Nation.

The ceiling of the Honolulu house was threatening to give way under the weight of unsold copies of Books 1 and 2 of the *"Flora Hawaiiensis"* and of stored lares and penates. No commercial warehouse accepted anything for storage. To add copies of "Plants of Hawaii National Park" to the overburdened attic was impossible. Moreover, in those days Honolulu was safe neither from invasion nor from bombing. In fact, during the speaker's stay in Honolulu, two or three bombs were dropped one night back of the house in the lantana on Round Top from a Japanese plane. This had jettisoned its deadly load in its frantic escape from our pursuers. So while hugging the phone for the anticipated call for the clipper flight, the speaker and his protege wrapped and addressed additional thousands of books, using the piano as table, for mailing as gifts to additional thousands of public libraries. It was practically impossible to leave the house for fear of missing the clipper call. Thus they lived like prisoners from February 1st till May 28th—four months!—when the welcome call at length came. Carrying their baggage allowance of fifteen pounds each, they were whisked away at break-neck speed by limousine to board the plane moored in Pearl Harbor. This had been stripped of unnecessary trappings to reduce its total weight for the carrying of additional air mail and passengers during the emergency. The speaker, eager to see from the air the islands he had botanized for years, was sorely disappointed. So long as the plane was within sight of land, all windows were blacked-out lest passengers observe sights of strategic importance. Upon arrival in San Francisco, the hegira to The New York Botanical Garden continued by bus.

The speaker finally learned he was a suspect. His return from Fiji to Hawaii five months previous to Pearl Harbor, his attempts to induce the plantations to import as laborers native Fijians instead of additional Orientals, and his mailing thousands of books from Hawaii to each community of 5,000 population or over throughout the entire United States was most suspicious. Were not these Hawaiian Floras actually code books in disguise planted in public

libraries for the convenience of dangerous enemy aliens? The archives of a foreign government possesses a stack of documents over an inch thick regarding the speaker, and the F.B.I., subjected him to scrutiny for his botanical activities before he was granted a clean bill of health. Regarding the 250 copies each of Books 3 and 4 of his *"Flora Hawaiiensis"* left in his beach home in rural Hawaii, many were destroyed by strangers who broke into the house to pilfer and ravage. Consequently, the five volumes dealing with the plants of the Hawaiian Islands are now unavailable and very rare indeed.

The huge collection of plants shipped from Hawaii to New York consisted mainly of undetermined species laid between sheets of newspaper. On their margins had been scribbled pertinent field data in the speaker's private shorthand, unintelligible to any one except himself. With induction into one of the Services likely should the draft scrape the dregs loose from the bottom of the barrel of available man-power, it was imperative to label the collection quickly at least so far as field data were concerned. This herculean task was accomplished within the year. The best set of plants was reserved for The New York Botanical Garden; the second, for the Arnold Arboretum; and additional sets were donated or sold to other deserving institutions. Thus the chain of events begun with the bombing of Pearl Harbor not only induced the speaker to put his botanical house in order but enabled him to be available for the address delivered to the members of the Torrey Botanical Club in New York City, April 18, 1945, on "Plant Life and Customs of the Hawaiian Islands."

The lecture, first illustrated with lantern slides, very briefly reviewed the origin of the different Hawaiian Islands and how the Hawaiian Archipelago became clothed with vegetation. This was followed by a discussion of ancient Hawaiian customs. These to a very large extent coincide with the present-day customs of the South Sea Islanders who, due to the exigencies of war, have been suddenly thrown amidst the clashing members of the highly technological civilizations(?) of the Japanese and of the White Race. The lecture ended with motion pictures. These showed the Hawaiian Islands to be a kaleidoscope of many races and combinations of races, a condition which the influx of the most virile members of the warring factions into the South Sea Islands is rapidly duplicating. Old Mr. & Mrs. Smith of Virginia, old Mr. & Mrs. Jones of Boston, old Mr. & Mrs. Goldstein of Fordham, and old Mr. & Mrs. O'Bryan of lower Manhattan will get the surprise of their long lives when their nut-brown, clear-eyed, healthy and attractive Eurasian grandchildren come to live with them shortly after the armistice in the Pacific has been signed. They will meet as members of their own families a race of beings superior in many ways to the poor, pure, effete white man. The meeting concluded with refreshments.

Locust Farm
Poughquag, New York

A Contribution to our Knowledge of the Wild and Cultivated Flora of Maryland—I

Harold N. Moldenke

The present paper comprises an annotated list of 303 collections of Maryland plants, representing 256 species and subspecific entities in 185 genera and 79 botanical families. It is one of a series by the same author on the flora of each of the states of the United States and several foreign countries.[1] The sequence of families followed is that of the author's preliminary classification of the Plant Kingdom,[2] which, in turn, is based, with modifications, on the latest available studies of the various groups—the systems of Engler & Diels and of Hutchinson being followed in major part.

It is a pleasure to acknowledge the generous and valuable assistance rendered the author by the following renowned specialists, who have examined material of the groups noted after their names: Dr. Liberty H. Bailey (*Erica, Leucothoë*), Dr. Nathaniel L. Britton (*Cyperus, Rynchospora*), Dr. Wendell H. Camp (*Gaylussacia, Vaccinium*), Mrs. Agnes Chase (Poaceae), Dr. Earl L. Core (*Cyperus*), Dr. Henry A. Gleason (*Agrostis*), Dr. Albert S. Hitchcock (Poaceae), Dr. Francis W. Pennell (*Gerardia*), and Dr. Truman G. Yuncker (*Cuscuta*). Each collection cited on the following pages which was examined by one of these specialists has the name of the specialist following the number in the list.

The first set of specimens herein cited is deposited in the Britton Herbarium at The New York Botanical Garden; other sets are in the herbaria of the University of Pennsylvania, University of Illinois, Missouri Botanical Garden, Duke University, Carthage College, Cornell University, Naturhistoriska Riksmuseum in Stockholm, Royal Botanic Gardens in Kew, Botanisches Museum in Berlin, Botaniska Trädgard in Göteborg, Conservatoire Botanique in Geneva, Jardin Botanique de l'Etat in Brussels, British Museum (Natural History) in London, the herbaria at Krakow and Vyskov, and elsewhere. The collection numbers, for citation purposes, are all H. N. Moldenke collection and citation numbers, although much of the material was actually collected by other collectors and turned over to the author of this paper for identification and distribution. These collectors, with the numbers of their collections and

[1] Moldenke, H. N., A contribution to our knowledge of the wild and cultivated flora of Ohio—I, Castanea **9**: 1-80. 1944; A contribution to our knowledge of the wild and cultivated flora of Florida—I, American Midland Naturalist **32**: 529-590. 1945; A contribution to our knowledge of the wild and cultivated flora of Massachusetts—I, Torreya **45**: 41-52. 1945.

[2] Moldenke, H. N., A preliminary classification of the plant kingdom to families, pp. 1-37, New York Botanical Garden, February 11, 1944.

the dates when they collected in Maryland, are as follows: Mrs. George Bishop, 1926 (*2860*); Dr. Earl L. Core, 1931 (*6769-6774, 6865*); Miss Alma Lance Ericson, 1942 (*13777*); Dr. L. P. McCann, 1938 (*10399*); Dr. Charles Edward Moldenke,[3] 1925, 1926, 1928, 1929, 1931, 1933 (*2743, 2818, 3094, 4190-4192, 4282, 4349-4353, 4391, 6591-6679, 7352-7353, 7879*); Mrs. Sophia Meta Moldenke, 1929, 1935 (*4393, 8425-8452, 9386-9387*); Charles E. & Sophia M. Moldenke together, 1926, 1928 (*3114-3116, 4172-4173, 4194*); Mr. Sylvester Scott, 1925 (*2784*); Mrs. Genevieve Scott, 1925, 1928, 1931, 1932 (*2474-2475, 2572, 4174, 6857, 6859*); and Dr. George M. Vandegrift, 1925, 1926, 1927, 1932 (*2428, 2560, 2641, 2845, 4527, 7253, 7379*).

Wherever the identification given here or the nomenclature here employed differs from that on the labels of the material when distributed, this fact is noted so that herbarium curators may make the necessary corrections, if they so desire. Where it differs from that of the author's previously published classified list of collections,[4] this fact is also noted on the following pages.

LECANORACEAE

Lecanora pallida (Schreb.) Schaer.—*Worcester Co.:* on tree trunks, Snow Hill, *8452.*

PARMELIACEAE

Parmelia conspersa (Ehrh.) Ach.—*Worcester Co.:* on trunks of *Malus pumila,* Snow Hill, *9387.*

Parmelia perforata (Wulf.) Ach.—*Worcester Co.:* on trunks of *Quercus alba,* Snow Hill, *8448,* inaccurately recorded on page 7 of the Annotated List as "*P. perforata* (Wulf.) Ack."

USNEACEAE

Ramalina calicaris (L.) E. Fries—*Worcester Co.:* on tree trunks, Snow Hill, *8449.*

Usnea barbata (L.) Wigg.—*Worcester Co.:* on tree trunks and limbs, Snow Hill, *8451.*

Usnea florida (L.) Web.—*Worcester Co.:* in tree trunks and limbs, Snow Hill, *8459,* inaccurately recorded on page 7 of the Classified List as "*U. florida* (L.) Wel."

BUELLIACEAE

Buellia parasema (Ach.) T. Fries—*Worcester Co.:* on trunks of *Malus pumila,* Snow Hill, *9386.*

OSMUNDACEAE

Osmunda cinnamomea L.—*Worcester Co.:* in marshy ground, Snow Hill, *8426.*

[3] Dictionary of American Biography **13**: 79. 1931; Science, new ser., **81**: 191. 1935; National Cyclopaedia of American Biography **24**: 54-55. 1935; Encyclopedia of American Biography **4**: 292-294. 1935; White's Conspectus of American Biography, ed. 2, 307. 1937; Who Was Who in America **1**: 853. 1942.

[4] Moldenke, H. N., An annotated and classified list of H. N. Moldenke collection numbers from no. 1 to no. 11,277, inclusive, pp. 1-135. New York Botanical Garden, December 6, 1939.

PINACEAE

PINUS TAEDA L.—*Worcester Co.:* in dry sandy pine woods, Snow Hill, *2578, 6655, 6903, 13820.*

TAXODIACEAE

SCIADOPITYS VERTICILLATA (Thunb.) Sieb. & Zucc.—*Baltimore Co.:* in outdoor cultivation, Baltimore, *2860,* inaccurately recorded on page 12 of the Classified List as "*S. verticillata* Sieb & Zucc." and so distributed.

TAXODIUM DISTICHUM (L.) L. C. Rich.—*Worcester Co.:* in swamps and along streams, Snow Hill, *2128.*

RANUNCULACEAE

COPTIS GROENLANDICA (Oeder) Fernald—*Baltimore Co.:* in Druid Hill Park, Baltimore, *5094,* distributed as *C. trifolia* (L.) Salisb.

DELPHINIUM AJACIS L.—*Worcester Co.:* in outdoor cultivation and escaped, Snow Hill, *2141.*

RANUNCULUS HISPIDUS Michx.—*Worcester Co.:* in moist pine woods, Snow Hill, *8445.*

VIORNA URNIGERA Spach—*Worcester Co.:* along fencerow, Snow Hill, *4192.*

BERBERIDACEAE

ODOSTEMON AQUIFOLIUM (Pursh) Rydb.—*Baltimore Co.:* in outdoor cultivation in Gwynne Park, Baltimore, *5106.*

FUMARIACEAE

FUMARIA OFFICINALIS L.—*Worcester Co.:* in sandy fields, Snow Hill, *4282.*

BRASSICACEAE

ARABIDOPSIS THALIANA (L.) N. L. Britton—*Worcester Co.:* in sandy waste soil, Snow Hill, *6911.*

BRASSICA NAPUS L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *4191.*

CAMPE BARBAREA (L.) W. F. Wight—*Worcester Co.:* in waste and cultivated ground, Snow Hill, *8441.*

VIOLACEAE

VIOLA ODORATA var. ALBA Bess.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *8446.*

VIOLA PRIMULIFOLIA L.—*Worcester Co.:* in bogs and boggy pine woods, Snow Hill, *6914, 8447.*

POLYGALACEAE

PILOSTAXIS LUTEA (L.) Small—*Worcester Co.:* along sides of wet ditches, Snow Hill, *7253,* distributed as *Polygala lutea* L.

POLYGALA SANGUINEA L.—*Worcester Co.:* in dry sandy fields, Snow Hill, *2150, 6619.* Both collections were cited on page 39 of the Classified List as *P. viridescens* L. and so distributed.

SAXIFRAGACEAE

MICRANTHES MICRANTHIDIFOLIA (Haw.) Small—*Garrett Co.:* Kelso Gap, Backbone Mountain, alt. 3000 feet, *6773* [*Core 2762*].

CARYOPHYLLACEAE

SILENE CAROLINIANA Walt.—*Worcester Co.:* in pine woods, Snow Hill, *8427.*

ALSINACEAE

Cerastium viscosum L.—*Worcester Co.:* in waste ground, Snow Hill, *8429.*

POLYGONACEAE

Persicaria pensylvanica (L.) Small—*Worcester Co.:* in dry sandy soil along shore, Snow Hill, *6664,* inaccurately cited on page 43 of the Classified List as *"P. pennsylvanica"* and so distributed.

Persicaria pensylvanica var. laevigata (Fernald) Ferguson—*Worcester Co.:* at edge of salt marsh near beach, Ocean City, *13836.*

Persicaria punctata (Ell.) Small—*Worcester Co.:* on sand-dunes of beach about ten miles south of Snow Hill, *6666.*

PHYTOLACCACEAE

Phytolacca americana L.—*Worcester Co.:* in sandy woods, Snow Hill, *6639.*

CHENOPODIACEAE

Ambrina ambrosioides (L.) Spach—*Worcester Co.:* in waste sand near beach, about ten miles south of Snow Hill, *6676,* distributed as *Chenopodium ambrosioides* L.; in sandy soil near beach, Ocean City, *13890.*

Chenopodium album L.—*Worcester Co.:* near beach, about ten miles south of Snow Hill, *6667.*

Chenopodium rubrum L.—*Worcester Co.:* in waste ground, Snow Hill, *4190.*

Salsola kali L.—*Worcester Co.:* in sand on dunes about ten miles south of Snow Hill, *6678.*

Spinacia oleracea Mill.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2144.*

AMARANTHACEAE

Celosia argentea L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2145.*

Celosia argentea var. pyramidalis Voss—*Worcester Co.:* in outdoor cultivation, Snow Hill, *6661.*

Froelichia floridana (Nutt.) Moq.—*Dorchester Co.:* abundant in dry sandy fields, Sharptown, *13848.*

GERANIACEAE

Erodium cicutarium (L.) L'Hér.—*Wilcomico Co.:* in dry sandy fields south of Delmar, *1257. Worcester Co.:* in dry sandy fields, Snow Hill, *4172, 8438.*

OXALIDACEAE

Xanthoxalis repens (Thunb.) Moldenke—*Worcester Co.:* in dry sandy waste soil, Snow Hill, *8440,* cited as *X. corniculata* (L.) Small on page 112 of the Classified List and so distributed.

Xanthoxalis stricta (L.) Small—*Worcester Co.:* in grassy lawns and waste ground, Snow Hill, *6928.*

BALSAMINACEAE

Impatiens balsamina L.—*Worcester Co.:* in outdoor cultivation and escaped, Snow Hill, *2131.*

LYTHRACEAE

Cuphea petiolata (L.) Koehne—*Kent Co.:* in dry sandy ditches, Galena, *13870.*

Lagerstroemia indica L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2143.*

OENOTHERACEAE

KNEIFFIA PERENNIS (L.) Pennell—*Garrett Co.:* White Rock Run, *6774* [*Core 2809*], distributed as *K. pumila* (L.) Spach.

RAIMANNIA HUMIFUSA (Nutt.) Rose—*Worcester Co.:* in dry sandy soil near beach, Ocean City, *13833.*

RAIMANNIA LACINIATA (Hill) Rose—*Worcester Co.:* in sandy fields, Snow Hill, *4350.*

CISTACEAE

CROCANTHEMUM MAJUS (L.) N. L. Britton—*Worcester Co.:* in sandy fields, Snow Hill, *4353.*

LECHEA RACEMULOSA Lam.—*Worcester Co.:* in sandy fields, Newark, *2151.*

CUCURBITACEAE

CITRULLUS VULGARIS Schrad.—*Worcester Co.:* in outdoor cultivation and escaped along roadsides and in waste places, Snow Hill, *2512.*

CUCUMIS MELO L.—*Worcester Co.:* in outdoor cultivation and escaped, Snow Hill, *3115.*

CUCURRITA PEPO L.—*Worcester Co.:* in outdoor cultivation and widely escaped, Snow Hill, *6656.*

MELASTOMACEAE

RHEXIA MARIANA L.—*Worcester Co.:* in wet roadside ditches, east of Willards, *13844.*

RHEXIA MARIANA f. ALBIFLORA Moldenke—*Dorchester Co.:* in wet ditches, Sharptown, *13849,* type collection.

RHEXIA NASHII Small—*Worcester Co.:* in sandy pine woods, Snow Hill, *6620,* distributed as *R. mariana* L.

HYPERICACEAE

TRIADENUM VIRGINICUM (L.) Raf.—*Dorchester Co.:* in wet sandy ditches along roadsides, four miles south of Federalsburg, *13853.*

MALVACEAE

ALTHAEA ROSEA Cav.—*Worcester Co.:* in outdoor cultivation and escaped, Snow Hill, *2149,* inaccurately distributed as "*A. rosea* L."

HIBISCUS SYRIACUS L.—*Worcester Co.:* in outdoor cultivation and persistent, Snow Hill, *2142.*

KOSTELETZKYA VIRGINICA (L.) A. Gray—*Worcester Co.:* in salt marsh near beach, Ocean City, *13837.*

EUPHORBIACEAE

ACALYPHA VIRGINICA L.—*Worcester Co.:* in waste ground, Snow Hill, *6623.*

CHAMAESYCE MACULATA (L.) Small—*Worcester Co.:* in sandy soil along roadsides and in waste and cultivated ground, Snow Hill, *6632,* cited on page 53 of the Classified List as *C. preslii* (Guss.) Arthur and so distributed, *13896.*

CHAMAESYCE POLYGONIFOLIA (L.) Small—*Worcester Co.:* procumbent on sand near beach, Ocean City, *13834.*

GALARHOEUS ESULA (L.) Rydb.—*Garrett Co.:* Kelso Gap, Backbone Mountain, *6772* [*Core 2763*], distributed as *Euphorbia esula* L.

GALARHOEUS HELIOSCOPIA (L.) Haw.—*Somerset Co.:* in dry sandy soil along roadside, north of Pocomoke, *1256,* distributed as *Tithymalus helioscopia* (L.) Hill.

RICINUS COMMUNIS L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2130.*

ROSACEAE

Fragaria virginiana Duchesne—*Worcester Co.:* in dry soil along ditches and in fields, Snow Hill, *8437.*

Potentilla canadensis L.—*Worcester Co.:* in dry sandy soil, Snow Hill, *8433.*

Potentilla pumila Poir.—*Worcester Co.:* in dry sandy soil, Snow Hill, *8432.*

Potentilla sp.—*Baltimore Co.:* in Gwynne Park, Baltimore, *5107.*

Spiraea tomentosa L.—*Worcester Co.:* at edge of woodlands, Snow Hill, *6621.*

MALACEAE

Aronia arbutifolia (L.) Ell.—*Worcester Co.:* in sandy woodland and at edge of pine woods, Snow Hill, *6907, 8435.*

Crataegus sp.—*Baltimore Co.:* in Gwynne Park, Baltimore, *5108.*

Malus angustifolia (Ait.) Michx.—*Worcester Co.:* in woods, Snow Hill, *2818.*

AMYGDALACEAE

Prunus angustifolia Marsh.—*Caroline Co.:* at edge of woods, near Preston, *5091.*

CAESALPINIACEAE

Chamaecrista fasciculata (Michx.) Greene—*Worcester Co.:* in sandy ditches and along margins of woodlands, Snow Hill, *2147, 6606.*

Ditremexa marilandica (L.) N. L. Britton & Rose—*Queen Anne's Co.:* in dry sandy soil along fencerows, Sudlersville, *13868.*

MIMOSACEAE

Albizzia julibrissin Durazz.—*Worcester Co.:* naturalized in swamps and along ditches bordering wood roads, Snow Hill, *2138, 7879.*

FABACEAE

Desmodium dillenii Darl.—*Worcester Co.:* in sandy soil at edge of woods, Snow Hill, *6634,* cited as *Meibomia dillenii* (Darl.) Kuntze on page 64 of the Classified List and so distributed.

Desmodium laevigatum (Nutt.) P. DC.—*Caroline Co.:* in dry sandy woodlands, American Corner, *13862.*

Desmodium marilandicum (L.) P. DC.—*Caroline Co.:* in dry sandy woodlands, American Corner, *13861. Worcester Co.:* in sandy ditches, Snow Hill, *6614,* cited as *Meibomia marylandica* (L.) Kuntze on page 65 of the Classified List and so distributed.

Desmodium paniculatum (L.) P. DC.—*Worcester Co.:* in sandy soil along roadside at edge of woods, Snow Hill, *6613,* cited as *Meibomia paniculata* (L.) Kuntze on page 65 of the Classified List and so distributed.

Desmodium rigidum (Ell.) P. DC.—*Worcester Co.:* along roadsides, Snow Hill, *6612,* cited as *Meibomia rigida* (Ell.) Kuntze on page 65 of the Classified List and so distributed.

Lespedeza capitata Michx.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6610.*

Lespedeza cuneata G. Don—*Dorchester Co.:* tremendous masses cultivated in dry sandy fields, Sharptown, *13851.*

Lespedeza repens (L.) Bart.—*Worcester Co.:* in dry sandy soil, fields, and along roadsides, Snow Hill, *6604, 6633, 6660.*

Lespedeza stuvei Nutt.—*Worcester Co.:* at edge of woods, Snow Hill, *6637,* inaccurately cited on page 65 of the Classified List as "*L. stuvei* Nutt." and so distributed.

LUPINUS PERENNIS L.—*Worcester Co.:* in pine woods, Snow Hill, *8428.*

MELILOTUS ALBA Desr.—*Worcester Co.:* in wet ditches, Snow Hill, *6650,* inaccurately distributed as "*M. alba* Desv."

SOJA MAX (L.) Piper—*Wicomico Co.:* extensively cultivated in fields and escaped, Willards, *13845.*

STROPHOSTYLES UMBELLATA (Muhl.) N. L. Britton—*Worcester Co.:* climbing over weeds along roadsides and in dry sandy woods, Snow Hill, *6636, 13895.*

TRIFOLIUM INCARNATUM L.—*Worcester Co.:* in cultivation in fields and escaped along roadsides, *2874.*

VICIA SATIVA L.—*Worcester Co.:* twining about herbs in fields, Snow Hill, *4351.*

MYRICACEAE

CEROTHAMNUS PENSYLVANICUS (Loisel.) Moldenke—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6905,* distributed as *C. carolinensis* (Mill.) Tidestr.

FAGACEAE

QUERCUS BICOLOR Willd.—*Baltimore Co.:* in woods, Gwynne Park, Baltimore, *5111.*

QUERCUS BOREALIS var. MAXIMA (Marsh.) Ashe—*Baltimore Co.:* in woods, Gwynne Park, Baltimore, *5101,* cited on page 69 of the Classified List as *Q. maxima* (Marsh.) Ashe and so distributed.

QUERCUS NIGRA L.—*Worcester Co.:* in dry sandy woods, east of Willards, *13841.*

QUERCUS PHELLOS L.—*Worcester Co.:* in dry sandy woods, east of Willards, *13840,* in woods and thickets, Snow Hill, *2474.*

QUERCUS RUBRA L.—*Worcester Co.:* in dry sandy woods, east of Willards, *13839,* some material of this number distributed as *Q. falcata* Michx.

MORACEAE

BROUSSONETIA PAPYRIFERA (L.) Vent.—*Baltimore Co.:* in Druid Hill Park, Baltimore, *5099,* distributed as *Papyrius papyrifera* (L.) Kuntze.

FICUS CARICA L.—*Washington Co.:* in outdoor cultivation, Hagerstown, *2743.*

ILICACEAE

ILEX GLABRA (L.) A. Gray—*Worcester Co.:* in dry sandy pine woods, Snow Hill, *13824.*

ILEX OPACA Ait.—*Worcester Co.:* along ditches, at margins of woods, and in pinelands, Snow Hill, *2475, 6733.*

CELASTRACEAE

EUONYMUS JAPONICA L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *6658, 6859.* Both collections were cited on page 72 of the Classified List as "*E. japonicus*" and so distributed.

LORANTHACEAE

PHORADENDRON FLAVESCENS Nutt.—*Worcester Co.:* parasitic on large *Nyssa sylvatica* trees, Snow Hill, *2784.*

VITACEAE

AMPELOPSIS ACONITIFOLIA Bunge—*Baltimore Co.:* in outdoor cultivation in small park near station, Baltimore, *13777.*

JUGLANDACEAE

CARYA PECAN (Marsh.) Engl. & Graebn.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2428,* cited on page 75 of the Classified List as *Hicoria pecan* (Marsh.) Britton and so distributed, *13825, 16857.*

NYSSACEAE

Nyssa biflora Walt.—*Caroline Co.:* at edge of woods, near Preston, *5090.*

ARALIACEAE

Hedera helix var. arborescens Loud.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2132.*

AMMIACEAE

Eryngium aquaticum L.—*Dorchester Co.:* in wet sandy ditches along roadsides, four miles south of Federalsburg, *13854.*

Pastinaca sativa L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2133.*

CLETHRACEAE

Clethra alnifolia L.—*Dorchester Co.:* in moist sandy woods, Sharptown, *13850.*

ERICACEAE

Erica parviflora L.—*Baltimore Co.:* in outdoor cultivation, Baltimore, *6514*, det. Bailey.

Eubotrys racemosa (L.) Nutt.—*Worcester Co.:* in moist sandy ground, Snow Hill, *4352*, cited on page 78 of the Classified List as *Leucothoë racemosa* A. Gray and so distributed.

Leucothoë catesbaei (Walt.) A. Gray—*Baltimore Co.:* in outdoor cultivation in Gwynne Park, Baltimore, *5110*, det. Bailey.

Menziesia pilosa (Michx.) A. L. Juss.—*Garrett Co.:* Backbone Mountain, *6771* [*Core 2745*], cited on page 79 of the Classified List as "*M. pilosa* (Michx.) Pers." and so distributed.

VACCINIACEAE

Cyanococcus vacillans (Kalm) Rydb.—*Garrett Co.:* Deer Park, *6769* [*Core 2727*]. *Worcester Co.:* in sandy woods and along roadsides, Snow Hill, *6906, 9798.* The second of these collections was distributed as *Vaccinium angustifolium* Ait. and re-identified as *V. vacillans* Soland. by Camp; the first and third were distributed as *V. vacillans* Soland., the latter so determined by Camp; all were cited on page 79 of the Classified List as *C. vacillans* (Soland.) Rydb.

Decachaena baccata (Wang.) Small—*Worcester Co.:* in sandy woods, Snow Hill, *9799*, det. by Camp as *Gaylussacia baccata* (Wang.) K. Koch and so distributed.

Polycodium stamineum (L.) Greene—*Worcester Co.:* in sandy woods, Snow Hill, *6904.*

OLEACEAE

Chionanthus virginica L.—*Worcester Co.:* in woods, Snow Hill, *2845.*

Ligustrum amurense Carr.—*Baltimore Co.:* in outdoor cultivation in Gwynne Park, Baltimore, *5104.*

ASCLEPIADACEAE

Asclepias exaltata (L.) Muhl.—*Garrett Co.:* along roadside, alt. 2600 feet, Wilson, *6880* [*Core 2751*], distributed as *A. phytolaccoides* Pursh.

Asclepias tuberosa L.—*Worcester Co.:* in sandy salt marsh near beach, Ocean City, *13891.*

RUBIACEAE

Houstonia caerulea L.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6912, 8436.*

CAPRIFOLIACEAE

ABELIA CHINENSIS R. Br.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *4194.*

ABELIA GRANDIFLORA (André) Rehd.—*Baltimore Co.:* in outdoor cultivation, Baltimore, *6515. Worcester Co.:* in outdoor cultivation, Snow Hill, *6657.* Both collections were inaccurately listed on page 83 of the Classified List as "*A. grandiflora* Rehd." and so distributed.

NINTOOA JAPONICA (Thunb.) Sweet—*Worcester Co.:* along fencerows, Snow Hill, *6645,* distributed as *Lonicera japonica* Thunb.

PHENIANTHUS SEMPERVIRENS (L.) Raf.—*Worcester Co.:* in outdoor cultivation and along fencerows, Snow Hill, *3114,* cited on page 83 of the Classified List as *Lonicera sempervirens* L. and so distributed.

SYMPHORICARPOS ORBICULATUS Moench—*Baltimore Co.:* in outdoor cultivation, in Druid Hill Park, Baltimore, *5095;* in outdoor cultivation, in Gwynne Park, Baltimore, *5105,* distributed as *S. vulgaris* Michx.

VIBURUM PRUNIFOLIUM L.—*Baltimore Co.:* in Druid Hill Park, Baltimore, *5097.*

WEIGELA FLORIBUNDA (Sieb. & Zucc.) C. A. Mey.—*Worcester Co.:* in outdoor cultivation Pocomoke City, *4393.*

XYLOSTEON CANADENSE (Marsh.) Duham.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2137,* distributed as *Lonicera canadensis* Marsh.

XYLOSTEON FRAGRANTISSIMUM (Lindl. & Paxt.) Small—*Baltimore Co.:* in outdoor cultivation, Druid Hill Park, Baltimore, *5096,* distributed as *Lonicera fragrantissima* Lindl. & Paxt.

CICHORIACEAE

HIERACIUM GRONOVII L.—*Worcester Co.:* in sandy woods, Snow Hill, *6593.*

HIERACIUM MARIANUM Willd.—*Garrett Co.:* Backbone Mountain, *6770* [*Core 2735*].

KRIGIA VIRGINICA (L.) Willd.—*Worcester Co.:* in dry sandy soil, Snow Hill, *8443.*

PRENANTHES ALBA L.—*Worcester Co.:* in sandy soil at edge of woods, Snow Hill, *6595,* cited on page 86 of the Classified List as *Nabalus albus* (L.) Hook. and so distributed.

AMBROSIACEAE

AMBROSIA ELATIOR L.—*Worcester Co.:* in waste and cultivated ground, Snow Hill, *6608, 6649.*

IVA ORARIA Bartlett—*Worcester Co.:* in salt marsh near beach, Ocean City, *13826.*

XANTHIUM ECHINATUM J. A. Murray—*Worcester Co.:* in dry sandy soil near beach, Ocean City, *13838.*

CARDUACEAE

ANTENNARIA PLANTAGINIFOLIA (L.) Richards.—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6908.*

ASTER EXILIS Ell.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6652.*

ASTER GRACILIS Nutt.—*Queen Anne's Co.:* in dry sandy woods, Sudlersville, *13867.*

ASTER NOVI-BELGII L.—*Worcester Co.:* in dry sand near beach, about ten miles south of Snow Hill, *6668.*

ASTER PUNICEUS L.—*Worcester Co.:* in sandy fields, Snow Hill, *6651.*

ASTER RAMOSISSIMUS Mill.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6659,* cited on page 88 of the Classified List as *A. ericoides* L. and so distributed.

BACCHARIS HALIMIFOLIA L.—*Worcester Co.:* at margin of salt marsh, about 10 miles south of Snow Hill, *6677.*

Bidens bipinnata L.—*Worcester Co.:* in waste and cultivated ground, Snow Hill, *6647*.

Bidens connata Muhl.—*Worcester Co.:* in ditches, Snow Hill, *7353*.

Bidens frondosa L.—*Worcester Co.:* in waste ground, Snow Hill, *7352*.

Bidens trichosperma (Michx.) N. L. Britton—*Caroline Co.:* in swampy ground, Goldsboro, *13865*.

Chrysopsis mariana (L.) Ell.—*Worcester Co.:* in sandy soil in fields and along roadsides, Snow Hill, *2139*, *6596*.

Conoclinium coelestinum (L.) P. DC.—*Cecil Co.:* in moist ditches along roadsides, Conowingo, *13803*.

Elephantopus nudatus A. Gray—*Worcester Co.:* in sandy ditches along roadsides, Snow Hill, *6622*.

Eupatorium aromaticum L.—*Worcester Co.:* in sandy soil, Snow Hill, *4173*.

Eupatorium hyssopifolium L.—*Wicomico Co.:* in dry sandy fields, Willards, *13846*. *Worcester Co.:* in sandy soil at edge of woods, Snow Hill, *6602*.

Eupatorium leucolepis T. & G.—*Worcester Co.:* in sandy woods, Snow Hill, *6617*.

Eupatorium purpureum L.—*Worcester Co.:* in sandy fields, Snow Hill, *6597*.

Eupatorium rotundifolium L.—*Worcester Co.:* in sandy fields, Snow Hill, *6603*.

Eupatorium serotinum Michx.—*Baltimore Co.:* in woods, Druid Hill Park, Baltimore, *5100;* Gwynne Park, Baltimore, *5103*.

Euthamia caroliniana (L.) Greene—*Worcester Co.:* in dry sandy fields, Snow Hill, *6609*, distributed as *E. tenuifolia* (Pursh) Greene.

Euthamia graminifolia (L.) Nutt.—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6594*.

Euthamia tenuifolia (Pursh) Greene—*Worcester Co.:* in dry sandy soil near beach, Ocean City, *13832*.

Gnaphalium obtusifolium L.—*Worcester Co.:* in sandy salt marsh near beach, Ocean City, *13889*.

Helianthus tuberosus L.—*Caroline Co.:* in moist ditches, Goldsboro, *13864*.

Leucanthemum vulgare Lam.—*Worcester Co.:* in sand at edge of fields, Snow Hill, *6616*, distributed as *Chrysanthemum leucanthemum* L.

Mikania scandens (L.) Willd.—*Worcester Co.:* climbing over coarse vegetation at edge of salt marsh near beach, Ocean City, *13831*.

Phaethusa occidentalis (L.) N. L. Britton—*Caroline Co.:* along roadsides near Preston, *5092*.

Pluchea camphorata (L.) P. DC.—*Worcester Co.:* in sandy salt marsh near beach, Ocean City, *13830*.

Senecio tomentosus Michx.—*Worcester Co.:* in sandy pine woods, Snow Hill, *6910*, *8430*.

Sericocarpus linifolius (L.) B.S.P.—*Caroline Co.:* in dry sandy woodland, American Corner, *13863*.

Solidago altissima L.—*Worcester Co.:* in sandy ditches and at margins of woods, Snow Hill, *6599*, *6624*. Both collections are cited on page 96 of the Classified List as *S. rugosa* Mill. and were so distributed.

Solidago bicolor L.—*Worcester Co.:* in sandy soil along side of wood roads, Snow Hill, *6592*.

Solidago hirsutissima Mill.—*Worcester Co.:* in sandy soil along roadsides and at margins of woods, Snow Hill, *6601*, *6611*. Both collections are cited on page 96 of the Classified List as *S. altissima* L. and were so distributed.

Solidago nemoralis Ait.—*Worcester Co.:* in sandy fields, Snow Hill, *6600*.

GENTIANACEAE

CENTAURIUM PULCHELLUM (Sw.) Druce—*Worcester Co.:* in sandy fields, Snow Hill, *2135.*

DASYSTEPHANA SAPONARIA (L.) Small—*Worcester Co.:* in moist ditches, Snow Hill, *6662.*

PLUMBAGINACEAE

LIMONIUM CAROLINIANUM (Walt.) N. L. Britton—*Worcester Co.:* in salt marsh near beach, about ten miles south of Snow Hill, *6672.*

PLANTAGINACEAE

PLANTAGO VIRGINICA L.—*Worcester Co.:* in dry sandy soil, Snow Hill, *8444.*

LOBELIACEAE

LOBELIA GLANDULOSA Walt.—*Dorchester Co.:* in wet sandy ditches along roadsides, four miles south of Federalsburg, *13852.*

LOBELIA PUBERULA Michx.—*Queen Anne's Co.:* in wet sandy ditches along roadsides, Ingleside, *13866. Worcester Co.:* in moist sandy ditches, Snow Hill, *6618.*

POLEMONIACEAE

PHLOX DRUMMONDII Hook.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *7379.*

BORAGINACEAE

BORAGO OFFICINALIS L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *3094.*

LITHOSPERMUM ARVENSE L.—*Worcester Co.:* in dry sandy ditches, Snow Hill, *8434.*

SOLANACEAE

DATURA STRAMONIUM var. TATULA (L.) Dunal—*Worcester Co.:* in dry sandy fields, Snow Hill, *6641,* distributed as *D. tatula* L., inadvertently omitted from the Classified List.

NICANDRA PHYSALODES (L.) Pers.—*Worcester Co.:* in waste sandy ground, Snow Hill, *3116,* cited on page 102 of the Classified List as *Physalodes peruvianum* Kuntze and so distributed.

PHYSALIS SUBGLABRATA Mackenzie & Bush—*Kent Co.:* in dry sandy soil along roadsides, Galena, *13872.*

SOLANUM CAROLINENSE L.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6642.*

SOLANUM NIGRUM L.—*Worcester Co.:* in sandy fields, waste and cultivated ground, Snow Hill, *2146, 6644.*

CONVOLVULACEAE

CONVOLVULUS REPENS L.—*Worcester Co.:* trailing in sandy fields, Snow Hill, *2560.*

CONVOLVULUS SPITHAMAEUS L.—*Garrett Co.:* in dry thickets, alt. 2500 feet, Deer Park, *6865.*

IPOMOEA BATATAS (L.) Lam.—*Worcester Co.:* in outdoor cultivation and escaped, Snow Hill, *2140.*

IPOMOEA LACUNOSA L.—*Caroline Co.:* very abundant, climbing over fenceposts, Federalsburg, *13858.*

PHARBITIS PURPUREA (L.) Voigt—*Caroline Co.:* climbing over fenceposts, Federalsburg, *13859.*

QUAMOCLIT COCCINEA (L.) Moench—*Caroline Co.:* very abundant, climbing over fenceposts, Federalsburg, *13857. Worcester Co.:* in outdoor cultivation and escaped along fences, Snow Hill, *6615, 6857.*

CUSCUTACEAE

CUSCUTA CAMPESTRIS Yuncker—*Wicomico Co.:* in dense colonies in fields of *Lespedeza*, Willards, *13847*, det. Yuncker.

SCROPHULARIACEAE

GERARDIA PURPUREA L.—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6598*, cited on page 104 of the Classified List as *Agalinis purpurea* (L.) Pennell and so distributed.

GERARDIA SETACEA Walt.—*Caroline Co.:* in dry sandy woodlands, American Corner, *13860*, det. Pennell, who says that this is the first record of the species from the east shore of the state.

LINARIA CANADENSIS (L.) Dumort.—*Worcester Co.:* in sandy fields and moist ditches, Snow Hill, *4349, 6909, 8439*.

VERONICA AGRESTIS L.—*Worcester Co.:* in dry sandy soil of lawns, Snow Hill, *8442*.

OROBANCHACEAE

OROBANCHE RAMOSA L.—*Baltimore Co.:* in Druid Hill Park, Baltimore, *5098*, erroneously distributed as "*O. racemosa* L."

BIGNONIACEAE

CAMPSIS RADICANS (L.) Seem.—*Worcester Co.:* along fencerows, Snow Hill, *2134*, cited on page 107 of the Classified List as *Bignonia radicans* L. and so distributed.

MARTYNIACEAE

IBICELLA LUTEA (Lindl.) Van Eselt.—*Baltimore Co.:* at edge of stream in Gwynne Park, Baltimore, *5109*.

VERBENACEAE

VERBENA HASTATA L.—*Cecil Co.:* in moist meadows, Conowingo, *13802*.

VERBENA OFFICINALIS L.—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6648*.

VERBENA PERUVIANA (L.) N. L. Britton—*Prince George's Co.:* in outdoor cultivation, College Park, *10399*.

VERBENA URTICIFOLIA L.—*Kent Co.:* in dry sandy soil along fencerows, Galena, *13869*. *Worcester Co.:* in wet ditches, Snow Hill, *6638*.

LAMIACEAE

HEDEOMA PULEGIOIDES (L.) Pers.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6663*.

MARRUBIUM VULGARE L.—*Worcester Co.:* in sandy ditches, Snow Hill, *6653*.

MENTHA PIPERITA L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *6646*.

MONARDA PUNCTATA L.—*Worcester Co:* in dry sandy pine woods and wet sandy ditches, Snow Hill, *6640, 13894*.

PYCNANTHEMUM ARISTATUM Michx.—*Dorchester Co.:* in wet sandy ditches along roadsides, four miles south of Federalsburg, *13855*.

PYCNANTHEMUM FLEXUOSUM (Walt.) B.S.P.—*Worcester Co.:* in sandy fields, Snow Hill, *6605*, cited on page 109 of the Classified List as *Koellia flexuosa* (Walt.) MacM.—erroneously as from New Jersey—and so distributed.

SALVIA AZUREA Lam.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2136*.

POTAMOGETONACEAE

POTAMOGETON AMERICANUS Cham. & Schlecht.—*Harford Co.:* in still water of pool in sandy cove, Spesutie Island, *9396*.

POTAMOGETON PECTINATUS L.—*Harford Co.:* in still water of pool in sandy cove, Spesutie Island, *9399.*

POTAMOGETON PERFOLIATUS L.—*Harford Co.:* in still water of pool in sandy cove, Spesutie Island, *9397.*

POTAMOGETON PUSILLUS L.—*Harford Co.:* in still water of pool in sandy cove, Spesutie Island, *9398.*

NAJADACEAE

NAJAS FLEXILIS (Willd.) Rost. & Schmidt—*Harford Co.:* in still water of pool in sandy cove, Spesutie Island, *9400.*

COMMELINACEAE

COMMELINA COMMUNIS L.—*Worcester Co.:* weed in dooryards and waste places, Snow Hill, *2641.* This number was also listed erroneously on page 40 of the Classified List as *Sedum triphyllum* (Haw.) S. F. Gray.

LILIACEAE

LILIUM SUPERBUM L.—*Worcester Co.:* along ditches and in grassy fields, Berlin, *2152.*

MUSCARI BOTRYOIDES (L.) Mill.—*Worcester Co.:* escaped along roadsides, Snow Hill, *8431.*

IRIDACEAE

SISYRINCHIUM ARENICOLA Bicknell—*Worcester Co.:* in sandy fields, Snow Hill, *4391.*

SISYRINCHIUM MUCRONATUM Michx.—*Worcester Co.:* in sandy fields, Snow Hill, *4527.*

ORCHIDACEAE

BLEPHARIGLOTTIS ALBIFLORA Raf.—*Worcester Co.:* in grassy ditches, Berlin, *2153.*

FISSIPES ACAULIS (Ait.) Small—*Worcester Co.:* in pine woods, Snow Hill, *6913.*

CYPERACEAE

CYPERUS ESCULENTUS L.—*Kent Co.:* in moist sandy ditches along roadsides, Galena, *13871,* det. Core. *Worcester Co.:* on sandy beach, about ten miles south of Snow Hill, *6665,* det. Britton; in sandy salt marsh near beach, Ocean City, *13835,* det. Core.

CYPERUS RETRORSUS Chapm.—*Worcester Co.:* in wet ditches, Snow Hill, *6629,* cited on page 22 of the Classified List as *C. torreyi* Britton, so det. by Britton, and so distributed.

CYPERUS STRIGOSUS L.—*Worcester Co.:* in wet ditches, Snow Hill, *6631,* det. Britton; on sandy beach, about ten miles south of Snow Hill, *6669,* det. Britton.

RYNCHOSPORA GLOMERATA (L.) Vahl—*Worcester Co.:* in moist ditches along roadsides, Snow Hill, *6628,* det. Britton.

SCIRPUS sp.—*Worcester Co.:* in sandy marsh at beach, about ten miles south of Snow Hill, *6670.*

POACEAE

AGROSTIS HIEMALIS (Walt.) B.S.P.—*Worcester Co.:* in swampy ground near highway, Snow Hill, *2148,* det. Gleason, cited on page 18 of the Classified List as *Panicularia grandis* (S. Wats.) Nash and so distributed.

ANDROPOGON GLOMERATUS (Walt.) B.S.P.—*Worcester Co.:* in dry sandy fields, Snow Hill, *6635,* det. Hitchcock.

ARUNDINARIA JAPONICA Sieb. & Zucc.—*Baltimore Co.:* in outdoor cultivation along stream in Gwynne Park, Baltimore, *5102,* det. Hitchcock.

ARUNDO DONAX L.—*Worcester Co.:* in sandy soil at edge of woods, Snow Hill, *6654,* det. Hitchcock.

Calamagrostis cinnoides (Muhl.) Bart.—*Worcester Co.:* in sandy fields and lawns, Snow Hill, *6626,* det. Hitchcock.

Cenchrus tribuloides L.—*Worcester Co.:* in sand on dunes, about ten miles south of Snow Hill, *6679,* det. Hitchcock; in dry sandy soil near beach, Ocean City, *13828.*

Distichlis spicata (L.) Greene—*Worcester Co.:* in sand along beach, about ten miles south of Snow Hill, *6674,* det. Hitchcock.

Echinochloa crusgalli (L.) P. Beauv.—*Worcester Co.:* in waste and cultivated ground, Snow Hill, *6607,* det. Hitchcock; in dry roadside ditches, east of Willards, *13843,* det. Chase.

Echinochloa walteri (Pursh) Heller—*Worcester Co.:* in sandy salt marsh near beach, Ocean City, *13827,* det. Chase.

Erianthus contortus Baldw.—*Worcester Co.:* in sandy soil at edge of woods, Snow Hill, *6591,* det. Hitchcock, said to be the first record for the state.

Erianthus saccharoides Michx.—*Caroline Co.:* at edge of marsh, near Preston, *5093,* det. Hitchcock.

Panicum amarulum A. S. Hitchc. & Chase—*Worcester Co.:* in dry sandy soil near beach, Ocean City, *13829,* det. Chase.

Panicum dichotomiflorum Michx.—*Worcester Co.:* in waste and cultivated ground, Snow Hill, *6630,* det. Hitchcock.

Panicum meridionale Ashe—*Worcester Co.:* in dry sandy pine woods, Snow Hill, *13823a,* det. Chase, who says "basal rosettes, autumnal phase with few spikelets hidden in sheaths."

Panicum verrucosum Muhl.—*Worcester Co.:* in dry sandy pine woods, Snow Hill, *13823,* det. Chase, who says "delicate annual with open panicles of warty spikelets."

Panicum virgatum var. cubense Griseb.—*Worcester Co.:* in sandy soil along roadsides, Snow Hill, *6643,* det. Hitchcock.

Paspalum floridanum var. glabratum Engelm.—*Worcester Co.:* in wet sand near beach, about ten miles south of Snow Hill, *6671,* det. Hitchcock.

Paspalum laeve Michx.—*Worcester Co.:* in sandy lawns, Snow Hill, *6625,* det. Hitchcock, erroneously cited as number "6623" on page 19 of the Classified List.

Saccharum officinarum L.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *2129.*

Setaria faberi Herrm.—*Worcester Co.:* in dry dusty roadside ditches, east of Willards, *13842,* det. Chase, who says this is the first record of the species for the state.

Sorghum halepense (L.) Pers.—*Dorchester Co.:* escaped along margins of corn fields, four miles south of Federalsburg, *13856.*

Sorghum vulgare var. drummondii (Nees) A. S. Hitchc.—*Worcester Co.:* in outdoor cultivation, Snow Hill, *4174,* cited on page 17 of the Classified List as *Holcus sorghum* var. *drummondii* A. S. Hitchc. and so distributed.

Spartina alterniflora Loisel.—*Worcester Co.:* on beach, about ten miles south of Snow Hill, *6673,* det. Hitchcock.

Triodia flava (L.) Smyth—*Worcester Co.:* on sand-dunes near beach, about ten miles south of Snow Hill, *6675,* det. Hitchcock.

Uniola laxa (L.) B.S.P.—*Worcester Co.:* at edge of sandy lawns and fields, Snow Hill, *6627,* det. Hitchcock; in dry sandy woods, Snow Hill, *13822,* det. Chase.

Box 240
North Warren, Pennsylvania

Kennedy and Heller (1905-1913)

Alan A. Beetle

Two of the lesser though bright lights in the botanical galaxy of the United States are P. B. Kennedy and A. A. Heller, the paths of whose orbits briefly converged during the early part of this century. The former died in 1930, the latter in 1944. Both were college trained men whose interests tended strongly although not exclusively toward taxonomic botany.

The years 1905-1913 seem to have been critical ones in the lives of both and are, as indicated by their correspondence, the only years during which their affairs were interrelated. The initiative was Heller's who first wrote on January 5, 1905 from Los Gatos, California, where he was in the printing business, to Kennedy, a professor of botany at the University of Nevada, in Reno, Nevada. Heller was offering specimens for exchange, at least 400 numbers from California collections of the past three seasons. He mentioned he was getting out original descriptions of North American plants, issuing them in series of 500 for $5.25 postpaid. The first series containing *Ribes, Castilleja, Artemesia,* and *Trifolium* he expected to be ready in March.

Kennedy, who was then undertaking a monographic study of *Trifolium,* responded immediately asking for both specimens and descriptions, so that on the 25th of the same month Heller wrote again in some detail not only of his own clover collecting which claimed his interest in spite of lack of time (how familiar a complaint) but asking for thorough collections of *Castilleja, Lupinus,* and *Ribes,* all of which he intended to study taxonomically.

Correspondence continued intermittently between the two until May, 1907 when Kennedy toured California and was able to spend several days visiting Heller at Los Gatos, collecting with him as far afield as Pacific Grove. The interest of both in *Trifolium* continued unabated even as did that of Laura McDermott, one of Kennedy's students who had gone to the University of California in Berkeley for graduate study.

This common enthusiasm for *Trifolium* seems to have brought the two men together and Kennedy decided to add Heller to the staff at Nevada. By October, 1907 Heller had already expressed his willingness to go to Reno but apparently there was red tape involved for in April of the next year Heller was still writing from Los Gatos and asking when. If it was going to be within two or three months he wanted to devote about all his time to the Catalogue but if later he wanted to do some collecting.

Kennedy seems to have received sympathetically this hint that Heller's living was in part dependent on his botanical collecting and subsequently set Heller to collecting clovers for him, at first in the vicinity of Los Gatos. But

by June the collecting fever had hit Heller hard and he was trying Chico and his other Sacramento Valley places; on June 23 he was just back from southern California and Catalina; and on June 25 he was writing from Yosemite Valley. In July he finally went to Nevada but spent the summer collecting and was not really settled in Reno until the fall of 1908.

Kennedy during this period was tied to his duties at Nevada but found time to write short articles for the journal "Muhlenbergia" which Heller was publishing. This journal, as Heller told his prospective subscribers, Cusick, Blumer, Beattie, Suksdorf, and others, was strictly concerned with systematic botany of the higher plants, in contrast, of course, to such other journals as were then being published. Kennedy joined with Heller in the publishing of "Muhlenbergia" in January, 1909.

Once together at Reno, Heller and Kennedy undertook work on *Trifolium* in earnest and borrowed material from many herbaria, both in the United States and abroad. Although Heller handled a good deal of the detail, the work on *Trifolium* was always referred to as Kennedy's while Heller kept up a running interest in a scattering of large and taxonomically difficult genera always with *Lupinus* a little in the lead. In November, 1911 he wrote W. W. Eggleston in his typically sincere but slightly cocky way "You mention that you are planning to work over *Lupinus*, and I gain from the way you put it that you are thinking of monographing the genus. If you have kept track of "Muhlenbergia" for the past two or three years you will find that I have been working at that genus quite a bit, and have announced my present writings as preliminary to an illustrated monograph. I have been living among lupines for the past nine years, and all that time have been studying the genus in the field, and for over a year have been growing some of them in the greenhouse. Last summer I put in much of my time while in Washington, New York and Cambridge, in looking up the types of *Lupinus* and getting photographs of them. I am putting an article into type right now that should do something toward clearing up the muddle about *L. laxiflorus*, and have settled the status of *L. bicolor* and *L. micranthus* by a special trip to the Columbia River* where I obtained *L. bicolor* from the type locality and typical material of *L. micranthus*. Unless you are able to get a better field knowledge of the genus than I have and a better array of supplementary information in general, you are liable to come out second best in the matter of a monograph. I am giving you this rather lengthy statement of the case in the hope that you will take up some other of the many genera needing an overhauling, and at which no one is working, such as *Phacelia, Castilleja, Penstemon,* and a host of others. But they should all be illustrated."

During this same period McDermott published her "Illustrated Key to

* Made in May, 1910.

the North American Species of *Trifolium*" which came as a surprise to nearly everyone. To Heller it was a particularly annoying volume because (as he wrote to E. L. Greene) "she recognized only 52 valid species out of 220 described species nearly all the others being worked into new combinations as varieties, and forms of varieties following the 'German system, classifying the plants into species, varieties and forms.' " Heller condemned it as "apparently a deliberate attempt to forestall Kennedy's work on the genus."

"Species crazy" was Kennedy's designation of Heller's taxonomic attitude, and perhaps characterized much of the work of the period. At any rate Kennedy seems to have influenced Heller's conception of taxonomic botany to a considerable degree and both, already strong advocates of field observation before monographic treatment, went so far as to write widely (even abroad) for seed, Kennedy for *Trifolium* and Heller for *Lupinus,* which they grew experimentally in their greenhouse.

The academic year of 1910-1911 was a sabbatical year for Kennedy and he used it for travel both in America and in Europe, especially England where he visited his mother. He was also taken so ill that he was forced to undergo an operation in London. He spent his time searching for types and gathering separates of both grass and legume literature.

In June, 1911, Heller travelled east to Pennsylvania State College where he "went through the ordeal of having a degree conferred in very nice shape, not being required to say anything at all, merely look pleasant and take what was coming to me." While in the East he visited both the New York Botanical Garden and the U. S. National Herbarium and returned to Reno in August to find that Kennedy's return had been delayed by his sickness; he was in Kalamazoo, Michigan, awaiting recovery. This meant that Heller had to undertake a considerable teaching load and was suddenly engaged all at once, in general botany, economic botany, and dendrology.

It may have been the lure of the land that persuaded Heller away from academic life at Reno. He found a piece of land near Oroville, California, and in April, 1913 wrote Kennedy "After looking over the property again am better pleased with it than ever. It is going to be a fine tract shortly." Heller then returned to Reno until June and finishing his duties, resigned and soon was back at Oroville to plant sweet potatoes. In October, 1913, he was writing "Melons grow like weeds here" and in December "We have lots of wet weather which means good botanizing as well as good crops."

Kennedy, himself, was not to stay long after Heller at Reno for in July, 1913, Prof. J. W. Gilmore, of the Division of Agronomy, College of Agriculture, University of California at Berkeley, California, wrote to Kennedy in regard to a position, and by the end of the year arrangements were complete.

On Christmas day in 1913 Heller wrote again to Kennedy, not to Reno but to Berkeley where Kennedy had moved, and this was the last letter for the

paths of life led them away from *Trifolium,* always their common meeting ground. Kennedy was never to move his headquarters again and Heller too remained for the most part in Butte County. It was incidentally also the death knell to the publication of "Muhlenbergia," and to ambitiously planned monographs of *Trifolium* and *Lupinus.*

Division of Agronomy
University of California
Davis, California

Report on Bomb Damage to Botanical Material in England

American botanists will probably be interested in the following excerpts from letters received by one of our members from Dr. Nicholas Polunin of Oxford University.

Dec. 7, 1943. "With regard to the English Botanical gardens I believe I am right in saying that they have sustained comparatively little damage from bombs, though I think I read somewhere of damage to a valuable fern house somewhere in Scotland other than Edinburgh. Here in Oxford we have fortunately escaped so far but Kew lost a good deal of glass and some plants early on. You doubtless heard of the serious damage to the Botanical Department of the British Museum? Most of the material was fortunately saved but several groups of Monocots were, I fear, considerably reduced. Fortunately all type specimens had been removed. I understand that this had not been done in Berlin and that there everything has been lost, which is indeed a tragic blow for our subject."

March 2, 1945. ". . . . we remain undamaged in Oxford where our most important ancient Herbaria have been below ground in safety since the summer of 1939. Kew have had some near flying bombs and, latterly, rockets, but so far as I know, no further serious damage. The British Museum of Natural History had a very near-miss flying bomb last summer after which my publisher, Leonard Hill, and I carted off the whole of their Arctic Botanical Collections to safety in his large car, since when there has been no further damage to the Museum. That bomb was indeed a near miss which the roof-spotter thought was coming right into the centre of the museum; but it veered off in the end and fell just in front of the main entrance which was, of course, badly blasted, as was practically every pane of glass in the place! Permanent damage to the botanical collections, however, seems to have been slight and, so far as I am aware, the same is true of such other botanical collections up and down the country as have been at all affected. Here we still have much of the Kew material and staff evacuated."

THE TORREY BOTANICAL CLUB

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Volume 20, no. 1, 172 pages, 1943, price $2.00.

(3) INDEX TO AMERICAN BOTANICAL LITERATURE

Reprinted monthly on cards, and furnished to subscribers at three cents a card.

Correspondence relating to the above publications should be addressed to

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Volume 45 December 1945 Number 4

TORREYA

EDITED FOR

THE TORREY BOTANICAL CLUB

BY

HAROLD H. CLUM

John Torrey, 1796-1873

CONTENTS

Some 19th Century Recollections of New York and Its Botanical Activities ..... Roland M. Harper 97
A New Mycelioid Chytrid: Myceliochytrium fulgens gen. nov. et sp. nov. ..... Alfhild E. Johanson 104
A Contribution to our Knowledge of the Wild and Cultivated Flora of Delaware—I ..... Harold N. Moldenke 106
The Behavior of the Flowers of the Aguacatillo (Persea caerula) ..... Alexander F. Skutch 110
Late Pleistocene Forests of Southeastern North Carolina ..... Murray F. Buell 117
Book Reviews
Aquatic Plants of the United States ..... Harold N. Moldenke 119
Flora of Illinois ..... Harold N. Moldenke 122
Field Trips of the Club 125
News Notes 133
Index to Torreya, Volume 45 134

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TORREYA

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The subscription price of Torreya in the United States and Canada is $1.00 a year, for subscribers elsewhere, 25c extra; single copies, 40c. Of the annual membership dues of the Torrey Botanical Club, $0.50 is for a year's subscription to Torreya.

Claims for missing numbers should be made within sixty days from the date of mailing.

Subscriptions and requests for back numbers should be addressed to the Business Manager, Miss Anne M. Hanson, Department of Botany, Columbia University, New York 27, N. Y.

Manuscripts for publication, books for review, reports of field trips, and news items should be addressed to:

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TORREYA

VOL. 45 DECEMBER 1945 No. 4

Some 19th Century Recollections of New York and Its Botanical Activities

ROLAND M. HARPER

In the fall of 1899 I went to New York to begin graduate work in botany at Columbia University. For two years immediately preceding I had lived in Massachusetts, and for ten years before that in Georgia, where I began the study of botany in the spring of 1895.

Up to 1899 my formal training in botany had been limited to an elementary course of about four months at the University of Georgia, given by a professor of "biology" who was primarily a zoologist, as in many small colleges at that time;[1] and it was chiefly devoted to the identification of flowering plants.

As far as I knew then, the main object of botanical investigation was floristic, discovering and describing as many species of plants as possible, and outlining their distribution, as the writers of manuals had done.[2] In Georgia I had used Gray's "School and Field Botany," Wood's "Botanist and Florist," and Chapman's "Flora of the Southern United States" (second edition) for plant identifications, and in Massachusetts I became acquainted with Gray's "Manual" (sixth edition). The first volume of Britton & Brown's epoch-making "Illustrated Flora" appeared in 1896, while I was still in Georgia, and I saw it there, but did not have much occasion, or opportunity, to use it until I came to New York.

While in Massachusetts I had gotten hold of a few odd numbers of the *Asa Gray Bulletin, Fern Bulletin,* and Torrey *Bulletin,* and had seen every issue of *Rhodora,* which began in January, 1899. I had also visited Cambridge

[1] It happens that this same man a few years before had written for the U. S. Bureau of Education a circular on biological teaching in the United States, which instigated a spirited discussion of the subject by Conway MacMillan and others, than ran through at least a dozen issues of *Science,* between April 7 and December 22, 1893, and covered nearly 14 large quarto pages. In the second series of the same magazine, over half a century later, between January 28 and June 9, 1944—nearly six pages in all—the same subject was thrashed out again, with very similar arguments, by five men who had apparently completely overlooked the controversy of 1893, though one of them did refer to an article on the subject published in 1919.

[2] For a discussion of the difference between flora and vegetation see TORREYA **17**: 1-3. January, 1917.

TORREYA for December (Vol. 45, 97-141) was issued January 25, 1946.

two or three times, and met Dr. B. L. Robinson, M. L. Fernald, and Dr. J. M. Greenman.

In the Torrey *Bulletin* I had been especially thrilled by Dr. John K. Small's articles on plants of the southeastern states, some of which I already knew. I had brought with me to New York for identification some of the plants I had collected in 1895-97, one of which turned out to be undescribed, and was named within a year (*Scirpus georgianus*).

At the time of my arrival in New York both undergraduate and graduate work in botany were carried on in Schermerhorn Hall, which looked about the same as today, externally at least, though it was not then so closely crowded by other buildings. Prof. L. M. Underwood was head of the department, and two graduate students, Howard J. Banker and David Griffiths, were working on fungi in an office next to his. Two other graduate students, Tracy E. Hazen and J. E. Kirkwood, were somewhere around the place, but I saw them less often.

The main building of the New York Botanical Garden was not quite completed, but the herbarium and exhibits were being moved into it, and it was opened to the public the following March. Dr. N. L. Britton, the director, Dr. Small and Mr. George V. Nash, head gardener, had already established homes near there, and they and Dr. P. A. Rydberg and a few others were on the grounds much of the time, getting things in order.

Dr. M. A. Howe, then curator of the Columbia herbarium, took me out to the Garden for my first visit on October 2. When we called on Dr. Britton, we found him and Mr. Nash making a list of plants in the Garden that had been killed by a freeze the night before. Somewhere in the wooded part of the grounds, in or near the hemlock grove, Dr. Howe showed me how the ripe fruits of *Polygonum virginianum* jump several feet from the plant when loosened by a touch; something I had never seen before.[3] (That distinguishes it sharply from typical *Polygonum,* and amply justifies its treatment by Small as a distinct genus.) The director's office was then temporarily in a two-story wooden building, a former residence, on the other side of the railroad, and plants were being mounted there. I believe it was there that I met Willard N. Clute and Percy Wilson not long afterward.

On account of my limited botanical training Prof. Underwood advised me to take an undergraduate laboratory course in elementary botany, under Dr. C. C. Curtis, who was then tutor in botany at Columbia, and had written a text-book on the subject, which we used. So I spent a few hours a week in his laboratory. There I learned something about microscopes, plant anatomy, etc., but the course did not interest me much. The text-books of those days

[3] Apparently the first satisfactory explanation of this phenomenon is that by Reed and Smoot in the Torrey *Bulletin* for July, 1906. There is also a short note on the subject by George T. Hasting in *Torreya* for December, 1932 (p. 169).

told nothing about ecology, mutation, or Mendelism, and if chromosomes were mentioned their significance was not known. Among Dr. Curtis's students at that time were Percy Wilson, previously mentioned, and two young men who were primarily zoologists, and afterward attained some distinction in that field, namely, R. A. Budington and G. G. Scott.

At first I thought I would take a minor in zoology, as many botanists did, but after attending one or two lectures, by Prof. E. B. Wilson, in that department on the floor above, I decided that that was not what I wanted, and I switched to paleobotany. The instructor in that was Dr. Arthur Hollick, on the first floor; and I was his only student at that time. I also had a minor in mathematics, under C. J. Keyser, in one of the old buildings, long since replaced by a modern one; and I stuck to that for two years, but did not get much out of it that I could use afterward.

One of my greatest privileges in those days was the use of the botanical library, then in Schermerhorn Hall, adjoining Prof. Underwood's office. It was not large enough then to require the services of a librarian, and Prof. Underwood looked after it, perhaps with some clerical assistance. He was a very active man, and among his other duties he was editing the Torrey *Bulletin*. The following year most of the library was moved to the Garden and combined with the Garden library, where Miss Anna Murray Vail had charge of the combined collection for several years. There the library grew rapidly.

I had never seen a botanical library before I went to New York, except perhaps for a glimpse at that of the Gray Herbarium, and I soon spent many hours in it, reading back numbers of magazines, and some of the books. In the magazines I found several New England local floras that Miss Mary A. Day had overlooked in her list just published in several numbers of *Rhodora,* and after I wrote her about them she included them in a supplementary list.

As my main interest then was in Georgia plants, I did not pay much attention to the local flora. But I soon became acquainted with a few halophytic plants—among them *Fucus vesiculosus,* a common brown alga—which were new to me because I had never lived near the coast before, and I also learned some weeds more characteristic of large cities than of small towns. A short trip by ferry from the foot of West 125th St., which I made with Prof. Underwood a few days after my arrival, took one to Fort Lee, N. J., where there were some interesting rocky woods along the Palisades.

On visits to friends at Jamaica, Long Island, I saw something of the woods near there, which I studied more intensively about 16 years later. The Hempstead Plains, a little farther out on the island, were then practically unknown to botanists, even to some who had crossed them by train on the way to Cold Spring Harbor; and I did not discover them until 1907.

Near the north end of Manhattan Island, then reached principally by trolley car, there were considerable areas of practically virgin forest, and I

remember seeing *Bicuculla Cucullaria* there for the first time, in the spring of 1900. Another novelty to me was *Claytonia virginica,* typically an inhabitant of rich woods, but there found also along the streets, in rich soils. At Riverdale, a little farther north, in the Bronx, were other wooded areas with streets winding through them. In that charming residential community lived E. P. Bicknell, an enthusiastic amateur botanist who worked in a business house downtown, and had astonished the local botanists a few years before by discovering previously unrecognized species of *Sisyrinchium, Asarum, Sanicula, Scrophularia,* and perhaps other genera, practically in his back yard.

About two weeks after arriving in New York I wrote some of my impressions of the city and its botanical activities in a long letter to my life-long friend Clarence H. Knowlton, an amateur botanist of Boston. About 43 years later he came across that letter again and returned it to me, thinking I might like to keep it. And the following quotations from it may be of present interest:

"Monday, Oct. 2nd, I found my way up to the college grounds. . . . I soon met Prof. Underwood, and had a little talk with him, and he introduced me to the other botanists who happened to be around, such as Dr. Curtis, Dr. Howe, Dr. Small, Dr. Rydberg, and two graduate students, Mr. Griffiths, of South Dakota, and Mr. Banker, of this state. Dr. Curtis is tutor in botany. . . . Dr. Howe, who got his Ph.D. last year, is now curator of the herbarium [of Columbia University]. . . . Dr. Small, his predecessor, is curator of the N. Y. Botanical Garden herbarium, which amounts to practically the same thing. . . .

"Monday afternoon I went out to the Garden, which is at Bronx Park, with Dr. Howe. I met out there Mrs. Britton, Dr. Britton, and Mr. Nash, the agrostologist. . . . The botanical garden covers about 250 acres, but most of it is woods, and very nice and primeval-looking woods, too. Much of it is dark rocky hemlock woods, . . . [On my last visit, in the summer of 1940, I found the hemlock forest considerably the worse for wear, so to speak.]

"They are building a big museum and greenhouses out there. I will have to go there for my graduate work in botany when the museum is finished, which will be about next month. Most of the herbarium has been moved from here [Columbia University] into the museum building already.

"Last Tuesday night, Oct. 10th, I attended the first fall meeting of the Torrey Botanical Club, which was held in the library of the College of Pharmacy, on 68th St. There was a great contrast, both in members and surroundings, between this meeting and that of the New England Botanical Club which I attended in June, . . .

"The Torrey Club met in a room with bare floor and low ceiling, and not very well lighted. No liveried attendants were there to respond to a press of the button, or take care of hats and coats, and no refreshments were served. But of course the character of the meeting depends less on the surroundings

than on the members. There just occurs to me one particular in which the Torrey Club has the advantage of the New England. The members do not smoke during the meetings. [Perhaps on account of the presence of ladies, who were—and I believe still are—barred from membership in the New England Botanical Club. There were one or two, possibly more, tobacco addicts at this meeting, but in those days no gentleman would have ventured to smoke in the presence of ladies.]

"Dr. Rusby, one of the vice presidents, presided, and Prof. Burgess (who gets about a dozen species out of *Aster macrophyllus*) was (and is) secretary. Judge Brown, the president [was absent]. . . . There were about 32 persons at the meeting, about 11 of whom were women. . . . Mrs. Britton (who by the way is the first female botanist I ever saw) was the only woman there that I knew.

"Among the men present were Dr. Britton (of course), Prof. Underwood, Dr. Small, Dr. Howe, Dr. MacDougal, Prof. Porter, the veteran botanist of Pennsylvania, Mr. A. A. Heller, the explorer of Hawaii, North Carolina, Porto Rico, Texas, etc., Prof. [Francis E.] Lloyd, Mr. Cornelius Van Brunt, an old gentleman whose name suggests his descent from the early Dutch settlers, Mr. Hazen, the present Fellow in Botany, Mr. Griffiths, Mr. Banker, and several others whom I did not know. Prof. Porter and myself were the only members of the N. E. Bot. Club present, as far as I know.

" . . . . This meeting was mostly devoted to reports of the excursions of the club since its last meeting in May. They get up excursions to various points within 50 miles or so about every week in the season. From these reports I learned of a lot of interesting plants that grow around here.

"Strange to say, the members do not seem to be at all familiar with the Britton & Brown nomenclature. . . .

"These meetings do not seem to be attended with as much interest and importance as those of the N. E. Bot. Club, but this is probably due to their greater frequency (twice a month for eight months in the year). . . . They sometimes elect from ten to twenty new members at one meeting."[4]

Besides the botanists already mentioned, I have pleasant recollections of the following met during my first year in New York, at the Garden, Columbia University, the Torrey Club meetings, or elsewhere:—Dr. T. F. Allen, Rev. L. T. Chamberlain, Rev. L. H. Lighthipe, Dr. H. M. Richards, Dr. J. N. Rose of the National Herbarium, and Mr. R. S. Williams.[5] Others equally

[4] For an official account of this meeting see Bull. Torrey Bot. Club, **26**: 639-641. December, 1899.

[5] It may be worth noting here that although the beard fashion had declined from its mid-19th century peak, about half the men mentioned in this article wore beards, and about half the remainder had mustaches.

Only a few of them are now living. Sketches of many of them can be found in "Who Was Who" Of 25 persons mentioned in this paper (not all of them botanists, though, nor

important appeared on the scene in the next year or two, but this narrative will be confined to the 19th century. There was probably no other place in the western hemisphere, with the possible exception of Boston and Washington, where so many botanists were concentrated, and knowing them was a wonderful opportunity for a beginner like myself. That was a time of great botanical activity, which bore abundant fruit in the next few years.

The American botanical journals of those days, as I recall them, were the Torrey *Bulletin,* founded in 1870 (while Dr. Torrey was still living) ; the *Botanical Gazette,* started as the *Botanical Bulletin* by the Coulter brothers a few years later; the *Fern Bulletin,* published by Willard N. Clute; the *Asa Gray Bulletin,* which had a brief existence in the 90's, and was superseded or absorbed by the *Plant World,* which in turn changed its form and management two or three times, and was succeeded by *Ecology;* the *Bulletin of the New York Botanical Garden,* an official publication or "house organ," started in 1895; *Rhodora,* the journal of the New England Botanical Club, started in 1899; and the *Journal of the New York Botanical Garden,* started in 1900. There were also two or three in the far West, and a few personal organs, besides some annual publications like that of the Missouri Botanical Garden, some appearing at irregular intervals, like the *Contributions from the U. S. National Herbarium,* and several magazines and scientific society proceedings that published important botanical papers but were not confined to botany.

It may be appropriate to record here an almost forgotten bit of local botanical history. At a meeting of the Torrey Club, it must have been some time in 1900, Prof. Underwood observed that the name "Bulletin of the Torrey Botanical Club" was too long and unwieldy, and suggested that it be changed to "Torreya." Although he was popular and influential, and was then editor of the *Bulletin,* his suggestion was received without enthusiasm, and I have found no mention of it in the published proceedings of the Club. But it evidently bore fruit, for at the beginning of 1901 the new magazine *Torreya* was launched, intended to carry articles shorter and more popular and of more local interest than the more technical ones in the *Bulletin,* which had a world-wide circulation. In fact it was much like the *Bulletin* had been in its first decade or two. It served its purpose well, and for twenty years it received enough manuscripts to publish an issue every month. Then it changed to a bi-monthly.

When I went to New York my first plan for research was simply to write a flora of Georgia, which was then a comparatively unworked field. But in the magazines I saw at Columbia I found the emerging science of ecology represented by a few articles in which the plants of various regions were

all New Yorkers) whose dates of birth and death are known, the average longevity was 71.5 years, which seems to be about the average for scientists in general. But nine who are still living average 76 years old at this time.

classified by habitat, which was a new idea to me, and appealed to me. During my first year there I wrote two articles on Georgia, classifying by habitat the plants around Athens, where I attended college from 1894 to 1897, and those around Americus, where I lived from 1892 to 1897, depending mostly on memory, for I took few notes in those days. These were published in the Torrey *Bulletin* for June and August, 1900. None of my preceptors at that time were interested in that sort of work, and they might have recommended other lines of research, but they did not try to discourage me. And that has continued to be my principal botanical interest ever since.

Summer schools were rare or unknown in those days, and I planned to spend the summer of 1900 in exploring as much as possible of Georgia, hoping to collect enough plants to pay the expenses of the trip, which I did. From members of the Columbia and Garden staffs I got the addresses of several herbaria in the United States and Europe that might like to buy my specimens, and I wrote to them beforehand, and soon got enough orders to justify the trip.[6] At the suggestion of Dr. Britton, Judge Brown lent me enough money to pay my traveling expenses,[7] which were kept rather low by the hospitality of several friends in Georgia whom I visited. For about four weeks that summer Percy Wilson of the Garden staff was with me, and it was an interesting experience for him, as he had never been so far from home before. (But the following year he went half way around the world with an astronomical expedition, and later he made many trips to tropical America.) The Georgia expedition, rounding out my first year at Columbia, yielded some interesting results in the way of new species and extensions of range. My report on it was published in the Torrey *Bulletin* for August, 1901, but nothing more need be said about it here, for that would be getting too far from New York, and carrying us beyond the 19th century with which this account has dealt.

University, Alabama

[6] Incidentally, most of the letters received from Europe were written with pen and ink, presumably indicating that typewriters—an American invention of about two decades before—were less common there than here.

[7] But did not donate it as one might infer from Dr. Britton's report in Bull. N. Y. Bot. Gard. **2**: 23. 1901.

A New Mycelioid Chytrid: Myceliochytrium fulgens Gen. nov. et Sp. nov.

Alfhild E. Johanson

In studying various saprophytic chytrids which occur in soil and fresh water in the eastern states an unusual species was isolated on bits of onion skin, grass leaves, and other substrata, which differs in many respects from all other known chytrids. This species is characterized primarily by a delicate, extensive, richly-branched filamentous thallus which is strikingly similar to the mycelium of the higher fungi and lacks the intercalary enlargements commonly present in most polycentric cladochytriaceous chytrids. Its zoospores, on the other hand, are posteriorly uniflagellate and structurally similar to those of most known chytrids. Accordingly, this fungus is regarded as a polycentric chytrid, and present observations indicate that it represents a new genus and species for which the name *Myceliochytrium fulgens* is proposed.

Myceliochytrium gen. nov.—Thallo polycentrico, intra-et extra-matricali, levibus mycelioidibus et ramosis capillamentis, diametro plerumque uniformi. Sporangiis terminalibus, extramatricalibus, singillatim vel acervatim occurrentibus. Zoosporis a posteriore uniflagellatis. Sporis perdurantibus dubiis vel non visis.

Myceliochytrium gen. nov.—Thallus polycentric, intra and extramatrical, consisting of fine, mycelioid, branched filaments of fairly uniform diameter. Zoosporangia terminal, extramatrical, occurring singly or in clusters. Zoospores posteriorly uniflagellate. Resting spores doubtful or unknown.

Myceliochytrium fulgens, sp. nov.—Rhyzomycelio exili et angusto, 1.3-1.7 μ diametro sine amplificationibus intercalaribus. Zoosporangiis hyalinis et maxime refractivis, parietibus tenuibus, .3-.6 μ, subsphericis, 5.5-8.7 μ, aliquatenus rectangularibus et truncatis, 6.6-17.5 x 10.3-26.2 μ, ovatis, ellipsoidalibus, 8.7-20.7 μ, urceolatis, 9.6-21 μ, late pyriformibus, 6.2-38.5 μ oblongatis, irregularibus vel saepe gibbosis; dehiscentibus ruptura vel deliquiscente pariete sporangiali. Zoosporis generatim linealiter constitutis; exinde sporangiorum species normalis; sphericis 1.3-2 μ, globulo parvo .5 μ refractivo; flagellis fere 11 μ longitudine; saepe enatantibus in sporangium, et emergentibus singillatim vel linealiter, sporangiis tumefacientibus et rumpentibus. Sporangiorum parietibus et rhyzomycelii relicitis, reagentibus negative ad examina cellulosa.

Myceliochytrium fulgens sp. nov.—Rhizomycelium delicate and narrow, 1.3-1.7 μ in diameter without intercalary enlargements. Zoosporangia hyaline and highly refractive with thin, .3-.6 μ walls, sub-spherical, 5.5-8.7 μ, somewhat rectangular and truncate, 6.6-17.5 μ x 10.3-26.2 μ, oval, ellipsoidal, 8.7-20.7 μ, urceolate, 9.6-21.0 μ, broadly pyriform, 6.2-38.5 μ, oblong, irregu-

lar, or frequently gibbose; dehiscing by rupture or deliquescence of the sporangial wall. Zoospores usually arranged in linear rows, giving sporangia characteristic appearance, spherical, 1.3-2 μ with a minute, .5 μ refractive globule; flagellum approximately 11 μ long; frequently swarming in sporangium, and emerging singly or in rows as sporangium swells and ruptures. Walls of sporangium and remainder of rhizomycelium reacting negatively to cellulose tests.

Saprophytic on vegetable substrata, chitin, and keratinized substrata in Connecticut, New York, Pennsylvania, New Jersey, Virginia and Louisiana, U.S.A., Amozonas and Matto Grosso, Brazil.

This species was first observed by Professor Karling in 1936 from material collected in New Jersey, but he did not observe zoospores and did not pursue his studies any further. It was rediscovered by the author in material from New York in 1944, and since that time Professor Karling found it as a saprophyte on various substrata in Amozonas and Matto Grosso, Brazil. Thus, it appears to be widely distributed in soil and water throughout the Western Hemisphere.

Since its resting spores are not definitely known, the taxonomic position and relationships of *M. fulgens* are not certain. As was noted earlier, the thallus lacks intercalary swellings and tapering rhizoids, characteristic of most polycentric chytrids, and resembles the mycelium of the higher fungi. Therefore, its inclusion in the family Cladochytriaceae at the present time is subject to question. Doubtless other similar fungi will be discovered in the future, and as our knowledge of the chytrids is extended the relationship of *M. fulgens* will become clearer and more certain.

The author wishes to express her gratitude to Professor John S. Karling for helpful criticisms and to Dr. Edwin A. Quain, S.J. for the Latin diagnoses.

Department of Botany
Columbia University

A Contribution to our Knowledge of the Wild and Cultivated Flora of Delaware—I

Harold N. Moldenke

The present paper comprises an annotated list of 66 collections of Delaware plants, representing 60 species and subspecific entities in 53 genera and 27 botanical families. It is one of a series by the same author on the flora of each of the states of the United States and several foreign countries.[1] The sequence of families followed is that of the author's preliminary classification of the Plant Kingdom,[2] which, in turn, is based, with modifications, on the latest available studies of the various groups—the systems of Engler & Diels and of Hutchinson being followed in major part.

It is a pleasure to acknowledge the generous and valuable assistance rendered the author by Mrs. Agnes Chase, who identified the material of *Eragrostis* and *Panicum,* the late Kenneth K. Mackenzie, who identified *Carex,* and Dr. Francis W. Pennell, who identified *Penstemon.*

The first set of specimens herein cited is deposited in the Britton Herbarium at The New York Botanical Garden; other sets are in the herbaria of the University of Pennsylvania, University of Illinois, Missouri Botanical Garden, Duke University, Carthage College, Cornell University, Carnegie Museum, Naturhistoriska Riksmuseum in Stockholm, Royal Botanic Gardens in Kew, Botanisches Museum in Berlin, Botaniska Trädgard in Göteborg, Conservatoire Botanique in Geneva, Jardin Botanique de l'Etat in Brussels, British Museum (Natural History) in London, Jardin Botanique de l'Université Jagellonienne at Krakow, Vaclav Skrivanek herbarium at Vyskov, and elsewhere. The collection numbers, for citation purposes, are all H. N. Moldenke collection and citation numbers, although the material of numbers *7503* to *7516,* inclusive, was actually collected by Dr. Charles Edward Moldenke[3] in 1933, the material of numbers *6680* to *6682,* inclusive, was collected by Dr. C. E. Moldenke and his wife, Mrs. Sophia Meta Moldenke, who col-

[1] Moldenke, H. N., A contribution to our knowledge of the wild and cultivated flora of Ohio—I, Castanea **9**:1-80. 1944; A contribution to our knowledge of the wild and cultivated flora of Florida—I, Am. Midl. Nat. **32**: 529-590. 1945; A contribution to our knowledge of the wild and cultivated flora of Massachusetts—I, Torreya **45**: 41-52. 1945; A contribution to our knowledge of the wild and cultivated flora of Maryland—I, Torreya **45**: 79-92. 1945.

[2] Moldenke, H. N., A preliminary classification of the plant kingdom to families, pp. 1-37. New York Botanical Garden, February 11, 1944.

[3] Dictionary of American Biography **13**: 79. 1931; Science, new ser., **81**: 191. 1935; National Cyclopaedia of American Biography **24**: 54-55. 1935; Encyclopedia of American Biography **4**: 292-294. 1935; White's Conspectus Am. Biog., ed. 2, 307. 1937; Who Was Who in America **1**: 853. 1942.

lécted together in the state in 1931, and that of numbers *17510* to *17518, 17525,* and *17911* to *17915* was collected by Morris and DeEtta Berd in 1945. Wherever the identification given here or the nomenclature here employed differs from that on the labels of the material when distributed, this fact is noted so that herbarium curators may make the necessary corrections, if they so desire. Where it differs from the author's previously published classified list of collections,[4] this fact is also noted on the following pages.

PINACEAE

PINUS TAEDA L.—*Sussex Co.:* in woodlands, near Selbyville, *6682.*

RANUNCULACEAE

CLEMATIS PANICULATA Thunb.—*Newcastle Co.:* escaped along roadside embankments, Mount Pleasant, *13804.*

BERBERIDACEAE

BERBERIS VULGARIS L.—*Newcastle Co.:* in outdoor cultivation, Wilmington, *7506.*

SAURURACEAE

SAURURUS CERNUUS L.—*Kent Co.:* in wet swampy woods, Dover, *2157.*

BRASSICACEAE

ARABIDOPSIS THALIANA (L.) N. L. Britton—*Sussex Co.:* in waste ground, Millsboro, *6917.*

CARYOPHYLLACEAE

AGROSTEMMA GITHAGO L.—*Kent Co.:* in rye fields, Felton, *7513.*

GERANIACEAE

ERODIUM CICUTARIUM (L.) L'Hér.—*Sussex Co.:* in sandy soil along roadsides, Millsboro, *6915;* in dry fields one mile south of Seaford, *7515.*

MELASTOMACEAE

RHEXIA MARIANA L.—*Kent Co.:* along roadsides, Smyrna, *2154.*

RHEXIA VIRGINICA L.—*Kent Co.:* in moist ditches along roadsides, Smyrna, *2155.*

MALVACEAE

HIBISCUS SYRIACUS L.—*Newcastle Co.:* escaped or persistent along roadside, Mount Pleasant, *13806.*

MALACEAE

ARONIA ARBUTIFOLIA (L.) Ell.—*Kent Co.:* at edge of woods, Smyrna, *5088.*

AMYGDALACEAE

PADUS VIRGINIANA (L.) Mill.—*Newcastle Co.:* in outdoor cultivation, Wilmington, *7507.*

CAESALPINIACEAE

CHAMAECRISTA NICTITANS (L.) Moench—*Newcastle Co.:* on grassy borders of woodland, Arden, *17914.*

MIMOSACEAE

ALBIZZIA JULIBRISSIN Durazz.—*Newcastle Co.:* in outdoor cultivation, Arden, *17911.*

[4] Moldenke, H. N., An annotated and classified list of H. N. Moldenke collection numbers from no. *1* to no. *11,277,* inclusive, pp. 1-135. New York Botanical Garden, December 6, 1939.

FABACEAE

Amorpha fruticosa L.—*Newcastle Co.:* in outdoor cultivation, Wilmington, *7505.*

Baptisia tinctoria (L.) Vent.—*Kent Co.:* in woodlands and along wood roads, Dover, *2156,* distributed as "*B. tinctoria* (L.) R. Br." and so cited on page 62 of the Classified List.

Cytisus scoparius (L.) Link—*Kent Co.:* in sandy soil, south of Dover, *1258a. Newcastle Co.:* large colony in sandy soil at edge of river, St. Georges, *1259.*

Lespedeza intermedia f. hahnii (Blake) Hopkins—*Sussex Co.:* in dry sandy woodlands, near Greenwood, *13814.*

Lespedeza procumbens Michx.—*Sussex Co.:* in dry sandy woods, near Greenwood, *13816.*

Lespedeza repens (L.) Bart.—*Sussex Co.:* in dry sandy woodlands, near Greenwood, *13815.*

Lespedeza stipulacea Maxim.—*Sussex Co.:* very abundant in pure-stand colonies bordering highway, near Greenwood, *13813.*

Lespedeza virginica (L.) N. L. Britton—*Kent Co.:* in large colonies in dry sandy fields, Camden, *13811.*

Lupinus perennis L.—*Sussex Co.:* in evergreen woods, Millsboro, *6920.*

Strophostyles helvola (L.) N. L. Britton—*Newcastle Co.:* climbing over dry embankments, Mount Pleasant, *13808.*

Trifolium arvense L.—*Kent Co.:* in sandy fields, Dover, *2127.*

Trifolium incarnatum L.—*Kent Co.:* in dry sandy fields, south of Dover, *1258;* in sandy field, Felton, *7511.*

Vicia cracca L.—*Kent Co.:* in sandy fields, Felton, *7512.*

AMMIACEAE

Sanicula marilandica L.—*Newcastle Co.:* in open woods, Arden, *17514.*

VACCINIACEAE

Decachaena baccata (Wang.) Small—*Sussex Co.:* at edge of woods, Delmar, *7508,* distributed as *Gaylussacia baccata* (Wang.) K. Koch.

RUBIACEAE

Diodella teres (Walt.) Small—*Newcastle Co.:* in dry soil along roadsides, Blackbird, *13810.*

CAPRIFOLIACEAE

Viburnum prunifolium L.—*Newcastle Co.:* in outdoor cultivation, Wilmington, *7504.*

CICHORIACEAE

Chondrilla juncea L.—*Newcastle Co.:* along fencerows, Mount Pleasant, *13807.*

Krigia virginica (L.) Willd.—*Sussex Co.:* in dry sandy fields, Millsboro, *6921.*

CARDUACEAE

Antennaria plantaginifolia (L.) Richards—*Sussex Co.:* in dry woodlands, Delmar, *7509.*

Aster dumosus L.—*Sussex Co.:* in dry sandy fields, near Selbyville, *6680.*

Bidens bipinnata L.—*Newcastle Co.* in waste soil and along roadsides, Mount Pleasant, *13805.*

Chrysopsis mariana (L.) Nutt.—*Sussex Co.:* very abundant in dry sandy fields, near Greenwood, *13812.*

Cirsium discolor (Muhl.) Spreng.—*Kent Co.:* along roadsides, Dover, *5089.*

Eupatorium verbenaefolium Michx.—*Sussex Co.:* in dry sandy woods, near Greenwood, *13819.*

HETEROTHECA SUBAXILLARIS (Lam.) Britton & Rusby—*Sussex Co.:* in sandy soil along roadsides, near Selbyville, *6681.*

PLANTAGINACEAE

PLANTAGO VIRGINICA L.—*Sussex Co.:* in dry sandy fields and along roadsides, Millsboro, *6926.*

BORAGINACEAE

LITHOSPERMUM ARVENSE L.—*Sussex Co.:* in waste ground, Millsboro, *6919.*

SCROPHULARIACEAE

LINARIA CANADENSIS (L.) Dumort.—*Kent Co.:* in dry fields, Felton, *7514. Sussex Co.:* in waste ground, Millsboro, *6918;* in dry fields, one mile south of Seaford, *7516.*

PENSTEMON DIGITALIS Nutt.—*Newcastle Co.:* in grassy meadows, Arden, *17518,* det. Pennell.

VERBASCUM BLATTARIA f. ALBIFLORUM (G. Don) House—*Newcastle Co.:* in dry grassy fields, Arden, *17517.*

BIGNONIACEAE

CAMPSIS RADICANS (L.) Seem.—*Newcastle Co.:* climbing over fenceposts along roadsides, Blackbird, *13809.*

LAMIACEAE

PHYSOSTEGIA VIRGINIANA (L.) Benth.—*Newcastle Co.:* growing as weed in cultivated ground, Arden, *17525.*

PYCNANTHEMUM FLEXUOSUM (Walt.) B.S.P.—*Newcastle Co.:* in grassy field, Arden, *17913.*

PYCNANTHEMUM VIRGINIANUM (L.) Durand & Jacks.—*Newcastle Co.:* in grassy field, Arden, *17912.*

CYPERACEAE

CAREX LURIDA Wahl.—*Newcastle Co.:* in moist sandy soil along ditches, St. Georges, *1260,* det. Mackenzie.

CYPERUS STRIGOSUS L.—*Newcastle Co.:* in moist ditches, Arden, *17915*

POACEAE

ARISTIDA DICHOTOMA Michx.—*Sussex Co.:* in wet sandy ditches, Millsboro, *6916,* distributed and cited on page 20 of the Classified List as *Sporobolus vaginaeflorus* Torr.

BROMUS COMMUTATUS Schrad.—*Newcastle Co.:* in grassy meadows, Arden, *17511,* det. Chase, *17513,* det. Chase.

DACTYLIS GLOMERATA L.—*Newcastle Co.:* in orchard near town, Arden, *17515.*

ERAGROSTIS CAPILLARIS (L.) Nees—*Sussex Co.:* in dry sandy woods near Greenwood, *13818,* det. Chase.

FESTUCA ELATIOR L.—*Newcastle Co.:* in grassy meadows, Arden, *17512,* det. Chase.

PANICUM POLYANTHES Schult.—*Sussex Co.:* in dry sandy woods near Greenwood, *13817,* det. Chase.

PHLEUM PRATENSE L.—*Newcastle Co.:* in grassy meadows, Arden, *17510.*

POA PRATENSIS L.—*Kent Co.:* in dry fields, near Harrington, *7510.*

TRIODIA FLAVA (L.) Smyth—*Newcastle Co.:* in margins of woods, Arden, *17516,* det. Chase.

THE NEW YORK BOTANICAL GARDEN
NEW YORK

The Behavior of the Flowers of the Aguacatillo (Persea caerulea)

Alexander F. Skutch

In 1929, stimulated by the work of Stout (1927) on the flower behavior of the avocado in subtropical Florida and California, I made brief observations on the anthesis of avocado trees growing in tropical Panamá (Skutch, 1932). During subsequent years, while collecting plants in Central and South America, I have tried to find other species of the same family which exhibit a similarly complex mechanism for favoring cross-pollination. The Lauraceae is well represented in the forests of tropical America, and many species were collected; but most were tall trees that bore their flowers at such heights that it was not practicable to make continuous observations upon them.

So far as has been determined, no species of the great genus *Nectandra* exhibits the double anthesis of the avocado. On the other hand, it seems probable that the flowers of the wild avocado or yas (*Persea Schiedeana*) would behave more or less like those of its congener; but the only flowering trees of this species that I have seen were forest giants whose inflorescences were displayed far beyond reach. Aside from the avocado, the only member of the laurel family in whose flowers I have actually observed double anthesis is the aguacatillo (*Persea caerulea*).

The aguacatillo (Fig. 1) is a small or medium-sized tree with a full, shapely, rounded crown of glossy, ovate or elliptical leaves. The tallest specimens I have seen were about seventy feet high. It is a tree of the clearings, often growing in pastures, and in Costa Rica is abundant between two thousand and five thousand feet above sea-level, both on the Central Plateau and in the basin of El General. I have never found it in heavy forest. In El General it generally sheds its foliage at the height of the dry season in February. The dying leaves turn a fairly vivid red and make a bright display of autumnal colors, rare among tropical trees. Because they put forth their new foliage while shedding the old, however, there are usually far more green than red leaves upon the aguacatillo trees. They are, therefore, never quite so colorful as many northern trees in autumn. The name "aguacatillo," applied to this tree by the Costa Rican country people, is the diminutive of "aguacate" (avocado). The fruit measures about 9 mm. in diameter and contains a single seed, like a miniature avocado seed, surrounded by a very thin, green pericarp. No larger than a pea, the fruit is far smaller than any true avocado and is eaten by birds. The glossy, leaden-gray drupes ripen in June.

When they have shed, in their colorful manner, all or practically all of their old foliage and have put forth a fresh set of glossy leaves of a bright, vivid green, the aguacatillo trees begin to flower, usually in March in El

General. The dull yellowish flowers are borne in loose panicles which spring, on long peduncles, from the axils of the full-grown new leaves. Each blossom (Figs. 5 and 6), at full expansion, is about a centimeter in diameter. It consists of three very small roundish sepals, three alternating and much longer, narrowly ovate petals, an outer whorl of six stamens and an inner whorl of three, which are slightly longer and have narrower anthers, and alternate with the petals. Six small, roundish nectar-glands are in pairs at the bases of the three antesepalon stamens of the outer whorl. Three much larger, sagittate glands

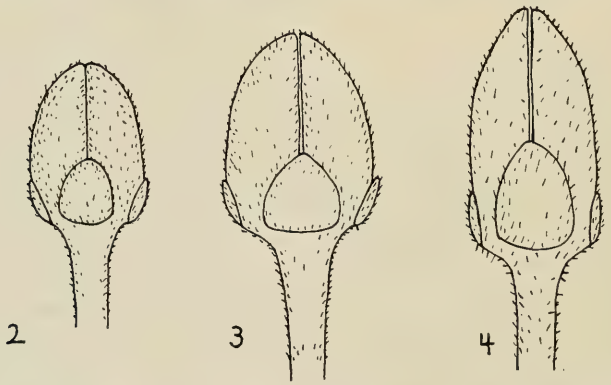
FIG. 1. Aguacatillo trees in March. Basin of El General, Costa Rica, altitude 850 meters.

alternate with the stamens of the inner whorl and hence lie above the petals. The flower has a single, simple pistil with a solitary ovule, unbranched style and oblique stigma. All parts of the flower are densely covered with a short, fine pubescence, except the glands, the anthers, and the pistil.

Each flower opens twice—on consecutive days. During the first opening (Fig. 5), the stamens lie against the petals, which are widely spread and lie all in one plane, and the anthers remain tightly closed. The pistil, however, stands up prominently in the center of the flower, with exposed and receptive stigma. Functionally the flower, during its first anthesis, is purely pistillate. After the termination of the first anthesis, the petals close tightly together again (Fig. 3); and during the period of closure the filaments of the stamens

elongate considerably, and there is a slight enlargement of all parts of the flower.

When it opens the second time (Fig. 7), the flower has an appearance quite distinct from that which it presented during its first anthesis. The petals bend outward even farther than before, until they become slightly reflexed. The stamens now no longer lie inconspicuously in contact with the petals, but stand up prominently in the center of the flower. The three innermost stand quite erect and parallel to each other; they rise above the stigma and almost conceal it. When the flower closed at the end of its first opening, they were shorter than the pistil; now they exceed it in length. The six outer stamens rise obliquely around the central group. Soon after the flower has opened, often before it has fully expanded, the anthers begin to open and to shed their pollen. Each anther dehisces by means of four elastic valves (Fig. 8), which

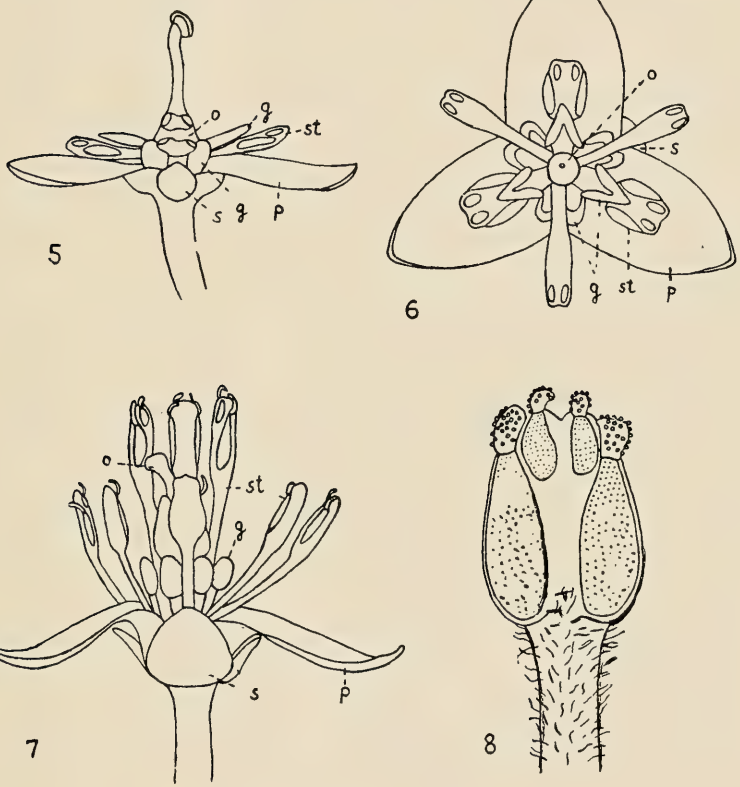


Figs. 2-4.—Fig. 2. Bud of aguacatillo one day before opening. Fig. 3. Flower closed after first opening. Fig. 4. Flower closed after second opening. All x 5.

were already prominent on the closed anthers during the first expansion of the flower. There are two long valves for the outer anther cells, and between them two much shorter valves for the two inner anther cells. These valves become detached from the walls of the cells everywhere except at their narrow upper ends. They rise upward and outward until they stand above their respective cells and extend slightly above the end of the anther. They would project far more prominently if they did not shrink so strongly upon opening. The mass of pollen from each cell remains attached to the erstwhile inner surface of the valve, which finally becomes convex, and is thus prominently exposed at the tips of the stamens. The stigma, which was already discolored at the beginning of the second anthesis, soon becomes quite black and withered. It appears to be no longer receptive and is largely concealed by the stamens. During its second opening, the flower is purely staminate in function.

If one examines a number of trees at any time while their flowers are in full anthesis, he will find that the flowers of some appear to be in their first

opening while those of others are in their second opening. All the myriads of open flowers on any one tree are always found to be in the same stage—either all in the first opening or all in the second. Thus it is possible to recognize two classes of trees, which, following Stout's work (1927) on the avocado, we may designate "A" and "B." If these two kinds of trees are watched during



FIGS. 5-8.—FIG. 5. Flower of aguacatillo in first opening, from side. Note declined stamens and unopened anthers; x 5. FIG. 6. The same, from above; x 5. FIG. 7. Flower in second opening from side. Note ascending or erect stamens and opened anthers; x 5. FIG. 8. Dehiscent anther of the outer series of stamens, with lifted valves and escaping pollen; greatly enlarged. g = nectar gland, o = pistil, p = petal, s = sepal, st = stamen.

two consecutive days, with a few of their flowers marked with bits of thread so that they can be recognized in their different stages, a pattern of behavior can be formed.

Class A comprises those trees whose flowers open for the first time at dawn, and for the second time toward the end of the following morning. The petals of the hitherto unexpanded buds begin to separate from each other at

the end of the night, and before dawn (about 5:15 a.m. at this season) they are already slightly spread. The petals bend outward very slowly, and it may be two hours after they first begin to expand (or 7:15 a.m.) before they reach their fullest opening. The flowers are evidently functional, however, long before this. The fresh stigmas are sufficiently exposed to receive pollen when the flowers are half open, an hour after the sky begins to brighten. The nectaries begin to secrete their sweet fluid as soon as the sun falls upon the trees, and insects come to the flower.

Between 4½ and 5 hours after daybreak, or from about 9:45 to 10:15 a.m., according to the day and the individual tree, the flowers begin to close, with their anthers still tightly sealed and their pollen all unshed, but with their stigmas as a rule somewhat discolored. In from forty-five minutes to an hour after they display the first signs of closing, the flowers have all practically closed, although the final tight pressing together of the edges of the petals, until the once-opened flowers come to resemble larger buds (Fig. 3), takes place more slowly. Then there are always a few laggards—flowers which have been injured by the bites of insects, or are otherwise not in perfect condition—that fold up more slowly.

These once-opened flowers remain tightly closed until they begin to open on the following day at about the same time that they began to close after their first anthesis. They require about three-quarters of an hour to reach full expansion. On some trees, the anther-valves begin to lift and to expose the pollen before the petals have fully spread; but on others they open more tardily, and do not begin to rise until half an hour or more after the flower has completed its expansion. Simultaneously with the opening of these second-period flowers, another set of flowers on the same tree, which opened for the first time that same morning, are closing again. Soon after two o'clock in the afternoon, the flowers, which have shed all of their pollen, close for the second time, after an opening which lasted between three and four hours. By three o'clock or a few minutes later, if the afternoon is dry and warm, as it usually is at this season, all but a few laggards have closed (Fig. 4). On wet afternoons the closing of the flowers may be considerably delayed. Once folded up, they do not open again. Those which fail to be pollinated, or at least fail to be fertilized, fall in their entirety after lingering on the tree for a few days, during which they remain tightly closed. Those whose ovaries begin to develop into fruits—apparently always a small minority—shed only the perianth and the stamens.

If the flowers of all of the aguacatillo trees in any neighborhood behaved exactly as those whose history has been followed, it would be very difficult for them to be pollinated; for at the time their stigmas are receptive there would be no pollen shed, and while they are shedding their pollen, there would be no stigmas in condition to receive it. A necessary part of this complex mechanism is a second class of trees, Class B, whose floral behavior is com-

plementary to that of the first. The flower buds of the trees of Class B expand for the first time between ten and eleven o'clock in the morning, at the same time that the flowers of the trees of Class A are opening for the second time. Probably because of the higher temperatures which prevail at this hour of the day, they reach their full expansion more promptly than the Class A flowers at their first opening; and their stigmas are ready to receive the pollen which the Class A flowers, open for the second time, now begin to shed.

The transfer of pollen from flower to flower is effected by the small insects which come in large numbers to the abundant nectar secreted by the floral glands. In flying from a tree of Class A to one of Class B, they may carry the pollen grains to the latter. The flowers of Class B close at approximately the same time in the afternoon as those of the other class. Their period of closure is considerably shorter, for they open again at the following dawn, only fifteen hours after they folded together at the end of their first opening. The valves of their anthers begin promptly to rise, and before the sun has appeared they are already shedding their pollen. This the insects may now carry to the stigmas of the newly opened flowers of neighboring trees of Class A. Thus the two kinds of aguacatillo trees reciprocate: during the early morning the Class B trees supply pollen to those of Class A; and during the middle of the day, the Class A trees furnish pollen for the stigmas of the flowers of their neighbors of Class B.

The flowers of Class B make their second and final closing at the same time that a new set of flowers on the same trees is opening for the first expansion, and at the same time that the first-period flowers of the Class A trees are closing and the second-period flowers of these trees are opening. The interval between ten and eleven o'clock in the morning is the time of greatest activity of the flowers of the aguacatillo trees, for then all of them are either opening or closing, and each individual tree changes, for a period, from functionally pistillate to functionally staminate, or the reverse.

The opportunities for self- or close-pollination of the aguacatillo flowers are very limited. Because one of two different sets of flowers on the same tree opens while the other is closing, it is not impossible that the pollen from a second-period flower of a Class A tree, which opens its anther-valves promptly, may be carried to the stigma of a first-period flower of the same tree that is slow in closing. Similarly, on a tree of Class B, lingering pollen of a second-period flower may possibly be transferred to the stigma of a first-period flower which has just been exposed by the separation of its petals. But because of the close synchronization of the opening and closing of the different sets of flowers, and because of the brief period during which the transfer of pollen from anther to stigma of the flowers of the same tree is at all possible, it seems unlikely that many close-pollinations occur.

The foregoing account of the behavior of the aguacatillo flowers is based upon observations made at Rivas, in the basin of El General, on the Pacific

slope of southern Costa Rica, at an altitude of 2800 to 2900 feet above sea-level, in the middle of March, 1937. In order to learn something of the relative abundance of the two classes of trees, I took a census of all those in the immediate vicinity. Most had low branches within reach of the ground. But even when all the branches of the tree were high, the flowers could be classified as either in the first or second opening at any given time by examining through eight-power binoculars those which stood in profile against the sky. Of 29 trees which I classified, 16 belonged to Class A and 13 to Class B. It seems that the two kinds of trees occur in approximately equal numbers.

SUMMARY

Each flower of the aguacatillo opens twice—on consecutive days. During the first opening the stigma is receptive; the stamens lie inconspicuously against the petals with anthers tightly closed. During the second opening, the stamens stand up prominently and the anther-valves lift to expose the pollen; but the stigma appears to be no longer receptive. Thus in its first opening the flower is, in function, purely pistillate; in its second, staminate.

According to the behavior of their flowers, two classes of trees are recognized. Class A comprises trees whose flowers open for the first time at dawn, remain expanded with receptive stigmas for four or five hours, then close late in the morning. Twenty-four hours later they open again and shed their pollen. The periodicity of Class B flowers is complementary to that of Class A flowers. Their first opening, with receptive stigmas, occurs late in the morning, when Class A flowers are expanding the second time and shedding their pollen. These Class B flowers open the second time early the following morning and expose pollen which may be carried to Class A flowers in their first anthesis. Thus, early in the morning, Class B trees supply pollen for Class A trees, whereas, in the middle of the day, the Class A trees furnish pollen for those of Class B. Because all the flowers on the same tree open and close almost simultaneously, self- or close-pollination appears to be rare. Insects, attracted by the abundant nectar from the floral glands, are the principal agents of pollination.

Trees of the two classes are found in approximately equal numbers.

San Isidro del General
Costa Rica

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Late Pleistocene Forests of Southeastern North Carolina

Murray F. Buell

An oak-pine-fir forest recorded by pollen preserved in lake sediments of fine clay existed in southeastern North Carolina in what definitely was Wisconsin time. Today there is no lake left, the clay sediments being overlain by eight feet of peat. The bog concerned lies just west of Jerome in Bladen County, North Carolina. It is ideally situated for recording the upland vegetation of the coastal plain of this section. It is immediately surrounded today by the sand hill vegetation of the turkey oak-long leaf pine community (*Quercus catesbaei* Michx.—*Pinus palustris* Mill.; Wells and Shunk, 1931) and a short distance to the west is a fairly extensive oak-hickory-loblolly pine forest. With the prevailing southwest winds, the bog and lake deposits of the Jerome bog basin could be expected to reflect both the xeric vegetation of the sand ridge which immediately surrounds the bog and the mesic vegetation of the sand plain west of it.

The pollen upon which this study is based was extracted from clay obtained by use of the American peat sampler (Davis type). Only the carefully extracted central portion of the core was used. The pollen slides were prepared by using the KOH method. The count was made from material mounted in Canada balsam. The measurements of the fir pollen and pine pollen were obtained from glycerine gelatin mounts which retain the fully expanded condition typical of KOH treated material (Cain, 1944a). The measurements of the fir and pine pollen are of grain length exclusive of bladders. (G-L, figure 1, p. 302 Cain, 1940). Percentages of pollen are given in terms of total tree pollen only.

Abies pollen occurs only within the bottom foot of the deposit and the maximum is at six inches above the bottom. There were six tree genera present at this time in sufficient quantities to leave their record. Three were of primary importance: *Quercus* 38%, *Pinus* 38% and *Abies* 12%. The other three were *Carya* 6%, *Betula* 5% and *Acer* 1%.

The Abies pollen ranges in size from 61.2 to 104.4 microns. The average of 100 measurements is 83.6 microns. The pine pollen based on 150 measurements, ranges from 36.0 to 64.8 microns. The size frequency curve is bimodal with a very pronounced peak at 46.8 microns and a secondary though very distinct one at 54.0 microns.

It would, of course, add a great deal if one could know the species. Thanks to Cain's size frequency technique, one can venture to suggest them for *Abies* and *Pinus*. There is little reason to suspect that the fir pollen is other than that of *Abies balsamea* (L.) Mill. or *A. fraseri* (Pursh) Poir. or both. Cer-

tainly the grain size is within the range (50-104 microns) given by Wodehouse (1935) for *Abies balsamea* and its mean (83.6) is close to those determined for these two species (*A. balsamea* 78.2, *A. fraseri* 79.8) by Cain (1944a). As for the pine the size frequency curve strikingly resembles that obtained by Cain (1944b) for fossil pine pollen from buried soils in South Carolina with one exception. The mode at 62.4 microns is missing. The other two peaks in the curve are the same in position and relative height. Cain concluded that the mode at 46.8 microns indicated the presence of *Pinus banksiana* Lamb. and that the mode at 54.6 indicated the presence of *Pinus glabra* Walt.

It is therefore reasonable to presume that the ancient lake Jerome was surrounded by a forest of jack pine on the surrounding coarse, sandy ridge. Beyond on the sand plain to the west was an extensive mesic forest with oak and fir predominating. It suggests a situation very similar to that existing as far north as northern Minnesota or New England where the northern conifer forest and the hardwood forest meet (Buell and Gordon, 1945). It may not, however, represent such a transition zone since Potzger found a similar mixed flora in bogs of the unglaciated part of New Jersey (Potzger, 1944). It is difficult to fit *Pinus glabra* as we know it today in this picture. It now occupies forests of the low, warm humid coastal region south of North Carolina.

There is no doubt that this forest should be referred to Wisconsin time. The pollen spectrum of the overlying peat is continuous to the present. Though the author's data are not completely worked out yet there is no indication of a severe cold period occurring since the abrupt disappearance of *Abies* above its maximum here described.

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BOOK REVIEWS

Aquatic Plants

Aquatic Plants of the United States. By Walter Conrad Muenscher. x + 374 pp. 154 figs., 400 maps. Ithaca, N. Y. Comstock Publishing Company. 1944. $5.00.

This is a compact and, in general, splendid manual of the herbaceous aquatic plants known to occur in the United States, based on many years of research by the author. Submersed and emersed species of fresh, brackish, and salt waters are included, as well as quite a few borderline species of bogs and salt marshes. Woody plants, however, such as *Cephalanthus, Taxodium, Salix, Rhizophora, Nyssa,* etc., are not treated.

Dr. Muenscher is professor of botany at the New York State College of Agriculture, Cornell University, and the book is volume 4 of the "Handbooks of American Natural History" series, edited by Albert Hazen Wright. Previously published volumes in the series treat the frogs and toads (vol. I), the mammals (II), and the salamanders (III). A second edition of the volume on mosquitoes (V) is now in press, and volumes on the lizards, snakes, fishes, and turtles are in preparation.

The format of the present volume is excellent; its size is such as to render it a very handy book to carry along in one's pocket on a field trip. It contains, first, a general introduction consisting of a brief account of the distribution of aquatic plants, their reproduction, vegetative propagation, fruit and seed production, the kinds and weights of seeds, and methods of storage and germination of seeds. Then follows a key to the families of aquatic plants enabling the student to refer a plant to its proper family. A key to genera is also provided for every family in which more than one genus is treated. There is a short generic description and a key to all the treated species in each genus, if more than one in number. Habitat and range are stated for each species and geographic distribution by states is shown by a series of 400 outline maps of the United States. These distributional maps comprise one of the most valuable features of the book. The large black dots placed in the outline of each state from which the author has records of the species in question, show the reader at a glance its general distribution and enable him to know where to search for it.

Naturally these maps are not always entirely accurate, but this is due mostly to the deplorable fact that not nearly enough collecting has yet been done in most of our states. Also, many records as published in local lists are often based on misidentifications and authors of books like the one under review

cannot be expected to check every one; indeed, many can never be checked because the actual specimens on which they were based are not preserved! Painstakingly assembled state floras are urgently needed for each state in the Union. Such state floras should contain an outline map of the state for each species and variety discussed and should show the distribution of that plant within the state by counties—as Deam's monumental "Flora of Indiana" (1940) and Gates' "Flora of Kansas" (1940) do. Only after such an exhaustive flora has been published for each state will workers on special groups of plants be able to make accurate distributional maps for the country as a whole. Compilers of such state floras—and the compilation of parts of such a state flora could easily be made the subject of masters' and even doctorate theses in state universities—should not only do extensive collecting in every county of the state, but should have the benefit of published lists of the collections of other botanists in that state, each such list having every record backed by an actual specimen preserved in a readily accessible herbarium where it will be available for checking by the compiler.

Nearly all the species in Muenscher's book are illustrated by excellent line drawings and there are many supplementary illustrations depicting differences in leaf-venation of species apt to be confused with one another, enlargements of fruits, etc. A unique feature of the book is the illustration of the seedlings of almost every species. This is a splendid innovation and entirely in line with the growing tendency among field botanists to learn to recognize members of the flora in stages of growth other than the flowering and fruiting condition. Herbarium and museum workers soon learn that a vast proportion of the specimens brought or sent in to them for identification by amateurs, ecologists, plant pathologists, anthropologists, and travellers, are "sterile," *i.e.*, do not bear the characteristic flowers and fruits. Botanists therefore have to learn to recognize species by their vegetative characters—sometimes even by their roots, in their dried or shriveled-up winter condition, or from miserably small fragments. Herbaria ought to preserve representative specimens of each species at every stage of its growth in order to assist workers in identifying such "sterile" material. Muenscher's study of the seedlings of all the plants discussed is an admirable step in this direction. More such studies are needed and more specimens of the various species in this and the various other pre- and post-flowering conditions are needed in herbaria!

Notes, based upon field observations, are given by Muenscher on the variability, special habitat requirements, special uses, and other features of many species. Differences in interpretation of various genera and species by different botanists are occasionally given. It is to be regretted that they are not given more uniformly. Common names are recorded for some, but not by any means

for all, of the species. Synonyms used by authors of other widely-used manuals are given in some cases. That they are not given in all cases is, in the opinion of this reviewer, one of the major defects of the book. Users of this manual will want to know not only what the correct name of each species is in the opinion of the writer, but also under what names the species may be found in other popular manuals such as Gray's "New Manual of Botany," Britton & Brown's "Illustrated Flora," Small's "Manual of the Southeastern Flora," Rydberg's "Flora of the Prairies and Plains," Deam's "Flora of Indiana," Marie-Victorin's "Flore Laurentienne," Lundell's "Flora of Texas," Jepson's "Flora of California," Hitchcock's "Manual of the Grasses of the United States," Abrams' "Illustrated Flora of the Pacific States," and such standard reference works as "Standardized Plant Names," "North American Flora," and Bailey's "Encyclopedia of Horticulture."

Generic synonyms are, indeed, given in some instances (*e.g., Justicia, Nuphar, Nymphaea, Suaeda*), but there seems to be no mention in the entire book of the generic names *Aranella, Biovularia, Bruneria, Calpidisca, Comarum, Lecticula, Neobeckia, Persicaria, Philotria, Piaropus, Setiscapella, Stomoisia, Tillaeastrum,* and *Vesciculina*—to mention only a few—which are accepted in one or more of the above-mentioned recognized manuals. It is astonishing to find no synonyms whatever given for the water-cress—a species which has a different scientific name in almost every manual one consults due to the exceptionally complicated nomenclatural tangles connected with that group of mustards! Although *Potamogeton heterophyllus* is a name adopted by Gray, Britton & Brown, Small, and Rydberg, it is not mentioned even in synonymy by Muenscher, nor is the name given under which Deam recognizes the plant.

The present reviewer can find no mention in the book, in synonymy or otherwise, of *Potamogeton floridanus, P. curtissii, Naias gracilis, Alisma subcordatum, Helanthium parvulum, Sagittaria stagnorum, S. lorata, S. filiformis, S. isoetiformis, S. cycloptera, S. mohrii, S. chapmanii, S. angustifolia, S. macrocarpa, S. pubescens, S. ornithorhyncha, S. viscosa, S. australis, Philotria linearis, Aranella fimbriata, Calpidisca standleyae, Utricularia pumila, U. macrorhiza, U. floridana, U. foliosa, Lemna trinervis, Xyris stricta, X. torta, X. communis, X. elata, X. scabrifolia, X. difformis, X. serotina, X. elliotti, X. pallescens, X. baldwiniana, Proserpinaca amblygona, P. platycarpa, Myriophyllum pinnatum, M. laxum, Nymphaea ulvacea, N. fluviatilis, N. chartacea, N. macrophylla, N. orbiculata, N. bombycina, Castalia minor, C. lekophylla, Eriocaulon lineare, E. körnickianum, E. texense,* and *Thalia geniculata,* to mention only a few of the species accepted in widely used manuals today. Does

the author regard all these as unworthy of specific rank? If so, to what species does he reduce them? The users of this book are certainly entitled to know.

The geographic ranges given are not always too accurate. For instance, *Castalia elegans* is recorded by Muenscher as occurring only in southern Texas. Actually, it is found also in the Big Cypress country of Florida, as Dr. Small has recorded in his Manual (p. 543) and elsewhere. Also, the reviewer wonders why the genera *Lachnocaulon* (with 8 species in the United States) and *Syngonanthus* (1 species) were omitted. They seem to be as worthy of inclusion as some of the species of *Eriocaulon* which are not truly aquatic. Natives of those states will be surprised that *Eriocaulon septangulare* is not recorded from Maine (where it occurs in at least six counties), Delaware, or Maryland (where it occurs in at least three counties). *E. compressum,* also, is known from Maryland and Louisiana and *E. parkeri* from eastern Pennsylvania.

Short bibliographies of the most pertinent literature are given at the close of most of the family treatments, but a general bibliography at the end of the book would have been helpful. Curiously, there seems to be no mention anywhere in the book of the very similar handbook published by Dr. Fassett in 1940.[1]

Readers will be fascinated by the figures which Dr. Muenscher gives concerning seed weights. For instance, the "seeds" of *Trapa natans* are about one million times as heavy as those of *Stomoisia cornuta,* of which it requires 175 million to make a pound! Aquatic grass seeds vary from 15,000 to 2,000,000 per pound; sedges from 80,000 to one million; *Xyris* from 35 to 50 million! The widespread occurrence of vegetative reproduction among aquatics and the various means of effecting this, are also admirably presented.

H. N. Moldenke

The New York Botanical Garden
New York

[1] Fassett, Norman C. A manual of aquatic plants. 382 pp. McGraw Hill Book Co. 1940

Flora of Illinois

Flora of Illinois. By George Neville Jones. The American Midland Naturalist Monograph No. 2, edited by Theodor Just. vii + 318 pp. 2 maps. Notre Dame, Indiana: University of Notre Dame. 1945. $4.00.

Up to the time of the publication of this work, no comprehensive treatment of the flora of Illinois had ever been published. As Dr. Blake has recently pointed out,[1] there are only 14 of our states that have a published flora "considered to represent in a fairly adequate and detailed way the present state of

our knowledge of plant distribution" in that state. Of these, only two are really comprehensive, with maps showing the known distribution of each species by counties within the state. Some of our states, like Florida and Idaho, have never had even an attempt at a state flora published; others have state floras which are so hopelessly out-of-date as to be practically worthless (*e.g.*, Kentucky, published in 1853; Louisiana, 1852; Massachusetts, 1835; South Carolina, 1816-1824). The only work on Illinois previous to this which might have any claim to the title of a state flora was Patterson's "Catalogue," published in 1876,[2] and consisting of a mere annotated list of 54 pages.

While Dr. Jones' book is based merely on field studies of the past five years and on herbarium specimens deposited mainly in the herbarium of the University of Illinois, it is an excellent piece of work and fills a gap in botanical literature. As the author himself states "it is hoped that the present study may serve to stimulate further interest in the local flora." The book will surely serve as a solid foundation on which Dr. Jones and others can later build a more comprehensive flora, in the fashion of Deam's work on Indiana,[3] based on much more field work and the examination of the material in many more of the world's important herbaria, with the distribution of each species indicated by counties on outline maps. In this connection one paragraph from Jones' introduction is well worth repeating here and deserves to be pondered by American taxonomists: "Although it is now almost a century and a half since the first botanical explorers visited Illinois, our knowledge of the botany of this region is far from complete. In a few areas fairly adequate botanical collections have been made, but more than half of the 102 counties of Illinois, according to the records at present, are almost wholly unexplored botanically. The distribution of the 'lower plants' of Illinois is comparatively unknown, and we lack even a check-list of the algae, fungi, and bryophytes. Obviously, much work remains to be done on the botany of Illinois."

Jones' book gives no detailed descriptions of the families, genera, or species treated, as most standard floras do, nor are there any illustrations of the plants, nor any specific distributional maps. Instead, the book is arranged in the form of a gigantic key, through which the student may carry his plant specimen and eventually arrive at the correct name. This key divides the vascular plants into two groups: (1) Seed Plants and (2) Ferns and Fern-allies. The Seed Plants are divided into: (a) herbaceous plants and (b) woody plants. These, in turn, are divided into 18 sections with easily-observed characters like "herbs with compound leaves," "grass-like plants," etc. Each of these sections contains one or more families. There follow keys to the genera

[1] Blake, S. F. State floras of the United States. Chron. Bot. 7: 258-261. 1942.

[2] Patterson, H. N. Catalogue of the phaenogamous and vascular cryptogamous plants of Illinois, native and introduced. 1-54. 1876.

[3] Deam, C. C. Flora of Indiana. 1-1236, *2250 maps*. 1940.

in each family and keys to the species in each genus (when more than one). Recommended common names are given for most (but, unfortunately, not all) of the genera and species. Authorities are given for scientific names, and all specific epithets are in lower-case. The keys to species include the most important diagnostic characters of the plant, a statement of its habitat, time of flowering, and the most important synonymy. Sometimes the frequency of occurrence of a species is indicated by the use of terms like "common," "local," "infrequent," etc., and actual herbarium specimens of rare or questionable plants are often cited to substantiate the record. A glossary, bibliography, list of taxonomic monographs and revisions consulted, author index, index to common and scientific plant names (lamentably not so complete as it should be), and an outline map of the state are included. The introduction gives a geographic, geologic, and topographic description of the state and goes into detail regarding its 8 vegetational divisions.

Of the 2124 species of vascular plants recorded by Jones (unfortunately he ignores entities beneath specific rank, as well as hybrids), 1786 are indigenous and 338 are either adventive or introduced. There are 302 species of trees and shrubs in 111 genera and 49 families—*Quercus, Salix,* and *Crataegus* being the three largest in number of species. Of herbaceous plants he records 1822 species in 713 genera and 113 families, with *Carex* the largest genus (114 species). There are 70 genera and 215 species of grasses in the state, *Panicum* being the largest genus.

Jones' nomenclature is, on the whole, very conservative as to family, generic, and specific limits, but in the choice of accepted names for the species treated he is up-to-date.

Let us have more such state floras!

Harold N. Moldenke

The New York Botanical Garden
New York

The following publications have recently come to the editor:

"The Cornell Plantations" is a new quarterly illustrated magazine published in the interests of a new project at Cornell University. This project originated as an idea for an arboretum at the University, but now it has been enlarged to include a unified development of the 3,000 acres of the University domain. As described by Liberty Hyde Bailey, emeritus dean of the College of Agriculture, the grass, and crops, and trees, the live-stock and wild animals, "are invaluable treasures and stimulators. All of them should be accessible and available in a single, comprehensive organized plan, whereby utility, personal interest, fertile suggestion, and beauty of localities and landscape may be brought to bear in a noble concept of education." The magazine is said to have a duel purpose: "First to be of interest and value to persons who are en-

thusiastic about the objects which the Plantations seek to foster; and, second, to help translate that enthusiasm into support for the enterprise of making an outdoor laboratory where Cornell students and professors can learn about things that grow, and where visitors, even from far countries, can study from living specimens." Among the articles published in the first three numbers are the following: Ten early flowering shrubs; A history of the Plantations development; Opportunities for cooperative research; Birds on the Plantations; Sheep for food, clothing, and pleasure; As an artist sees the beauties of landscape; and When to cut roses. The editor is Professor Emeritus Bristow Adams, and the address is: "The Cornell Plantations" Roberts Hall, Cornell University, Ithaca, N. Y.

The latest numbers of two series of publications of The Black Rock Forest, Cornwall-on-the-Hudson, N. Y., have also been received.

Flinn, R. F. The leaching of some plant nutrients following the burning of forest litter. Black Rock Forest Papers **1** (No. 21): 128-134. 1943. Price 50¢.

Tryon, Henry H. The management of young volunteer hardwood stands. The Black Rock Forest Bulletin No. 13: 1-28. 1945. Price $1.00.

From Cuba, two publications have been received:

Del Valle, C. G. El maiz dulce. Estacion Experimental Agronomica, Santiago de las Vegas, Cuba, Bulletin 62: 1-18. 1945. This discusses the development of varieties of sweet corn suitable for growth in Cuba.

Roig y Mesa, Juan Tomas. Plantas medicinales, aromaticas o venenosas de Cuba. Parts 1 & 2. We hope to publish a review of this work in the near future.

FIELD TRIPS OF THE CLUB

April 28. Albion, N. J. This was a joint outing with the Academy of Natural Sciences of Philadelphia to the Jersey pine barrens. *Lupinus perennis* and *Hudsonia ericoides* were in full bloom. A large number of the expected plants were seen. Leaders, Charles E. Mohr, John M. Fogg, Jr., Arthur LaDow and W. L. Dix. Attendance about 60.

April 29. Arden, N. Y. for lichens. Eighty-four species were recorded, the longest list yet for a single day trip. The early spring was evident from the report: "*Rhododendron nudiflorum,* seen in flower in this same region on April 15, was mostly faded. *Coptis trifolia* was past full flower. In full flower were *Vaccinium corymbosum, Polygala paucifolia, Carex stricta.* In each case the first flowers must have appeared at a much earlier date, probably new records for earliness." Leader, G. G. Nearing. Attendance 11.

May 5. Watchung Reservation, Union County, N. J. A list was compiled of 100 plants, one milk snake, slimy salamander, duck nesting, and a variety of worms, centipedes, bugs and beetles. Leaders, Miss Nellie Louise Condon and Mrs. G. E. Anderson. Attendance 13.

May 6. Silver Lake, White Plains, N. Y. A dull day held the bird list down to 30 species and the flowering plants were no longer plentiful due to the advanced season. It was nice to have the president of the club along and two members from California, Mr. and Mrs. George Hastings. Leader, Miss Farida A. Wiley. Attendance 19.

May 6. Morris Arboretum, Philadelphia. Several species were seen in flower. A number of uncommon tree species were seen. *Quercus benderi,* a scarlet oak-red oak hybrid and a huge specimen of *Alesia diptera.* The silver bell tree attracted particular attention. Leader, L. E. Hand. Attendance 2.

May 12-13. Camp Thendara, Palisades Interstate Park. This joint outing with the New York Section of the Green Mountain Club has been a favorite for many years. A very pleasant outing can be had without adding any new species to the list. Leader, Mrs. Laura W. Abbott.

May 13. Prospect Park, Brooklyn. Many large trees were observed during a fine walk. English elm, American elm, ginkgo, European beech, cutleaved beech, black walnut, willow oak, turkey oak, English oak, London plane, pagoda tree, Sassafras, and numerous smaller trees including Bronssonetia, osage orange, white mulberry, magnolia, Chinese elm, etc., were noted in particular. Leader, Dr. Alfred Gundersen. Attendance 11.

May 19-20. Watchung Reservation. The annual nature meeting of the Club was held here instead of at Branchville, N. J., because of travel and hotel restrictions. This was made possible through the generosity of the Union County Park Commission. Mr. James Hawley and other members of the Museum Committee at the Reservation arranged a program of walks and talks that proved to be very interesting and instructive. A staff of over 30 individuals, largely from the nature clubs of Union County, provided talks, displays, and leadership for many walks. A horseback tour of attractive nature spots in the Reservation proved popular. Mr. and Mrs. Robert Rulison were host and hostess. A complete report with bird and plant lists has been deposited with the Field Committee. Attendance was over 120.

May 26. Haskell, N. J. A walk through the Chicohikie Falls section turned in a list of 18 fungi. All participants reported a good time, in spite of mosquitoes. Leader, Fred Lewis. Attendance 6.

May 27. Greenwich, Conn. In spite of a heavy rain, eleven people walked through the Audubon Nature Center for three hours, and brought in a

list of 36 species of birds—plants receiving passing notice. Through the courtesy of the Nature Center the group saw two reels of film in color showing nesting birds. Another contribution by one of those present was selections from "Bird-lore Anthology" written by Scollard and Rittenhouse and published by Houghton Mifflin. Leader, Henrietta Dotson.

May 27. Tohickon Creek, Bucks County, Pa. Another record of inclement weather. The list of plants from last year was increased materially, particularly by additional sedges, of which collections were made for the Academy of Natural Sciences of Philadelphia. The party consisted of L. W. Hand, leader, Hollis Koster and W. L. Dix.

May 30. Woodlands, N. Y. Good weather for a good trip. In spite of the early season, *Amorpha fruiticosa* was only in incipient flower, and Mr. Shipley's garden was not yet in full bloom. The refreshments were an unquestioned success. Leader, Alexandra Kalmykow. Attendance 11.

May 30. Lawrence Harbor, N. J. A walk around the watershed of Cheesequake Creek, including Cheesequake State Park, traversed the following plant communities: salt marsh, fresh bog, shoreline of ponds, white cedar swamp, scarlet oak coppice, sand pits and waste land. Leader, John A. Small. Attendance 25.

June 2. Montefiore Hospital, Bronx, N. Y. The poor weather was reflected in the meager attendance. However, Dr. Michael Levine's garden was in beautiful shape and we join him in "better luck next time."

June 2. Atlantic Beach, Long Island. This group worked fast and got in a full trip in time to take shelter during the heavy rain, and then went on with a beach party. A long list of zoological interest was compiled and plants characteristic of the area were noted. This was a joint outing with the Department of Natural History at Brooklyn Institute. Leader, Grace Petersen. Attendance 41.

June 3. Jockey Hollow, Morristown, N. J. This trip was rained out but we are indebted to the leaders, Elsie Weig and Lois Wenman who offered the walk.

June 9-10. Medford Lakes Region, Jersey Pine Barrens. A very profitable joint trip with the Academy of Natural Sciences of Philadelphia. Anderson's tree frog (*Hyla andersonii*) was seen, also several reptiles. A black snake (*Coluber constrictor*) was caught with a young bluebird in its mouth. The more interesting plants reported were "Mountain laurel in profusion, *Utricularia inflata,* var. *minor, Magnolia virginiana, Amianthium muscaetoxicum, Opuntia vulgaris* (not in bloom), *Helonias bullata* (not in bloom), and *Dryopteris simulata.* To the botanical connoiseur, perhaps the splendid dis-

play of *Amianthium muscaetoxicum, Scleria pauciflora,* var. *caroliniana,* and what Mr. Lewis was almost certain was *Amanita gemmata,* might appeal." Leaders, E. T. Wherry, R. B. Gordon, Theodor Hass and Arthur LaDow. Attendance well over 50. Reported by Hollis Koster.

June 10. Mount Vernon, N. Y. was substituted for the more exposed walk announced, due to the threat of rain which fully materialized during the afternoon. During the short period of botanizing a number of the expected plants were found. Leader, Mary Holtzoff. Attendance 5.

June 17. Mt. Peter, N. Y. The specialists never appear. Four competent botanists each made a list which is on file with the field committee. After consolidation it was found that 216 seed plants, 16 ferns, 9 mosses, 1 liverwort, 12 fungi, and 45 lichens had been recognized on a little over two miles of trail. So the botanical survey of the Appalachian trail moves along a bit. Leader, G. G. Nearing. Attendance 11.

June 24. Haskell, N. J., to tramp the Glenwild circular with the New York Mycological Society. The cool spring reduced the numbers of fungi but Boleti and Russulas were found. Some of the party collected the water lichen. Leader, F. R. Lewis. Attendance 10.

June 30. The New York Botanical Garden. The walk was led by the President of the Club, Dr. Fred J. Seaver. The best find of the day was *Colus Javinicus,* a phalloid known from only two stations in North America, a single collection from Pittsburgh, and occasional collecting at the present station. It had not been collected in several seasons until Dr. Donald P. Rogers came across it on this walk. Attendance 10.

July 1. Nepera Park, Yonkers, N. Y. A pleasant walk was reported with observation of the natural history of the area in a general way. Leader, Eleanor Friend. Attendance 7.

July 7. Ward's Point, Staten Island. This area which is rapidly being encroached upon by "development" offers an interesting study from year to year. A single plant of *Lythrum alatum* Pursh was found. Norman Taylor describes this plant as "Unknown on L. I. and S. I., formerly near Fordham, very rare northward." The distinctness of the plant found from *L. hyssopifolia* has been checked at the Brooklyn Botanic Garden. There was quite a display of butterfly weed. *Allionia,* reported last year, was found again but no *Polanisia* was seen. Leader, Charles Ericson. Attendance 12.

July 14. West Orange, N. J. To visit the fern garden of Mr. W. Herbert Dole. Eighty odd species of ferns with markers were growing and a number of probable hybrids that were not marked. The leader also reports, "My climbing fern, which has done so well for the past ten years, failed to put out any new

fronds this spring, though one of last year's is still green." Attendance was over 22.

JULY 15. SOUTHFIELDS, N. Y. This season seems to have been particularly unfortunate in its hiking weather. The report: "Last Sunday's trip to Southfields was done in almost continuous rain, which started before I left home and amounted at times to a downpour. All ten of us got wet but had a good time and named many fungi which the moisture had brought out abundantly." Leader, G. G. Nearing.

JULY 21. HASKELL, N. J. Though the attendance was too small (2) the trip was pronounced most successful by the leader, Fred R. Lewis. The effects of the rains were evident and a list of 79 species has been filed with the field committee.

JULY 22. SINAC, N. J. The high water made botanical exploration difficult. Leader, Joseph Monachino. Attendance 8.

AUGUST 5. EGG HARBOR CITY, N. J. The station for *Schizaea* mentioned by Witmer Stone (page 128 in "Plants of Southern New Jersey") is apparently lost "and the search for *Rhexia aristosa* was also unsuccessful but a number of interesting species were seen such as *Eupatorium resinosum, E. leucolepis, Solidago stricta, Polygonum Careyi, Smilax Walteri, Habenarian cristata,* etc. On the return a stop was made at Pleasant Mills, near Batsto, to visit the station for *Breweria Pickeringii* which was in bloom and also growing nearby was *Crotonopsis linearis.*" Leaders, L. E. Hand and Hollis Koster. Attendance 5.

AUGUST 5. SLOATSBURG, N. Y. The walk extended to Ramapo Torne Mt. Fungi were plentiful, 67 species recorded, but nothing unusual. Leader, F. R. Lewis. Attendance 13.

AUGUST 12. SURPRISE LAKE, PASSAIC COUNTY, N. J. An abundance of fungi and other interesting plants was reported from this walk. Blueberries also were plentiful. Leader, G. G. Nearing. Attendance 11.

AUGUST 19. INTERSTATE PARK, N. Y. "The Deep Hollow trip last Sunday was attended by 15. I proposed that instead of trying to cover a lot of country, we should explore rather thoroughly the little valley of that name. so we did, finding *Serapias Helleborine,* which none of us knew, *Monotropa Hypopitys,* in unusual abundance, and the rare fungus, *Tremellodon gelatinosum.* Mushroom pickers were able to fill their baskets. The season has been remarkable for fungi, and many trips have turned into mushroom hunts." Leader, G. G. Nearing.

AUGUST 26. SCHUNEMUNK MT., N. Y. No report received. Leader, Dr. Alexander V. Tolstoouhov.

September 2. Windbeam Mt., Midvale, N. J. Another rainy trip but there were lichens and fungi as promised. Leader, G. G. Nearing. Attendance 3.

September 8. Springfield, N. J. This trip failed. The supervisory personnel of the nursery changed in the early summer and although Mr. Jennings notified the field chairman, there was no way to call off the trip. We regret that the new management was unsympathetic, and the inconvenience caused those who went.

September 9. South Beach, Staten Island. Mrs. Holtzoff was ill but sent her daughter to the rendezvous to inform those who appeared that the trip could not be held. We appreciate this thoughtfulness.

Mrs. Mary Holtzoff did not recover from the illness. Though not a member of the Club, Mrs. Holtzoff was our very good friend and for a number of years had offered two or more walks each season in our schedule. We extend sympathy to her family.

September 9. Englewood Cliffs, N. J. This is the second season in succession in which the fungi have been unexpectedly scarce on this walk. No new forms appeared. Leader, F. R. Lewis for E. D. Hallock. Attendance 9.

September 15-16. Forked River, N. J. A visit to the pine barrens dry areas, bogs, marshes, coast strip, and Barnegat Bay shore, with the Academy of Natural Sciences of Philadelphia joining us. In addition to botanical walks there was an evening Kodachrome show by Mr. and Mrs. Arthur LaDow, a morning bird walk led by Charles Mohr, and a demonstration of microscopic plant structure by Dr. Theodor Hass. Mr. Nearing soon had an enthusiastic group of lichenologists under way. They even visited a cemetery, where a variety of stone-inhabiting species were brought to light. Mr. Beales produced a variety of grasses, some of them to be transplanted to his garden. A particular prize was *Erianthus giganteus*. One hundred thirty-one species and two varieties were added to the list of 256 species of mosses, ferns, and seed plants compiled in 1944. In addition a list of 65 lichens and 22 fungi was turned in this year. Copies of the complete list are available on request to the chairman of the field committee. The question is, shall we go back to Forked River in 1946? If so what time would you prefer? Announced leaders present, Louis Hand and Hollis Koster. Attendance 45.

September 22. Ward's Point, Staten Island. Although announced for Richmond, the chairman's carelessness about directions (for which apologies) took the group to Ward's Point again. A good time was had by all, and to the amazement of the leader, some fox grapes were found in fruit. Though wild grape vines grow all over the Island it seems that fruit is rare. Goldenrod and asters were abundant, *Allionia* was still flourishing, and a single plant of *Polanisia* was found. Some of the group particularly enjoyed the inclusion of

birds in the observations of the trip. Leaders, Mr. and Mrs. Redjives, due to illness of Mr. Charles Ericson. Attendance 7.

September 23. Towaco, N. J. The high lights of this walk were the discovery of a remarkably large stand of lady's tresses and plenty of fringed gentians at the right stage of development. Leader, H. B. Gordon. Attendance 6.

September 30. Douglaston, Long Island. The plants reported as being most interesting to the group were: *Centaurea Cyanus, Agalinis purpurea, Leptamnium virginianum, Polygonella articulata, Salicornia europaea, Atriplex hastata, Limonium carolinianum, Mikania scandens, Strophostyles helvola.* In addition a bird list of 28 species was reported. Leader, Farida A. Wiley. Attendance 8.

September 30. Mineola, Long Island. This trip was held under the leadership of Mr. Joseph Rispaud. Mr. Robert Hagelstein, who has offered this trip for many years was in the hospital at the time. We are sorry to announce that Mr. Hagelstein died on October 20. He had been associated with the Torrey Botanical Club for many years and contributed a great deal to the informative part of our program.

October 6. Haskell, N. J. The inclement weather kept down the attendance but not the mushrooms. The good ones collected were saved and cooked at Brook's Camp. Everyone was sold on the flavor of the wild ones. Leader, Fred R. Lewis. Attendance 3.

This was Fred's last trip for us, for a while anyway. He is moving to Florida. In fact, he held off a much cherished vacation trip to Vermont before his departure for Florida because he said, "Can't let the gang down." We have appreciated his leadership, enjoyed his company, and certainly we wish him well in his new habitat.

October 7. Brooklyn Botanic Garden. A study of some of the rare trees of the Garden was made. Leader, Alfred Gundersen. Attendance 6.

October 7. Fort Lee, N. J. "Disagreeable dripping weather." Mr. Nearing led the trip at the request of Mr. Hallock who was ill. The group saw one falcon and a small rainbow but no fungi, no hawks, no complaints. Attendance 3.

October 14. Point Pleasant, N. J. The expected species of plants and 40 species of birds were observed on the fall shore trip which included the ponds at Point Pleasant, Sea Girt and Spring Lake as well as the ocean front. Among the water birds seen were two gannets, baldpates, blue-winged teel, ruddy ducks, pied-billed grebes, coots, cormorants, and greater yellow legs.

Four species of gulls were present in various plumages. Those included: Herring, ring-billed, laughing, and great black-backed. Leader, David Fables. Attendance 13.

October 14. Arden, N. Y. An observation of late autumn flora, lichens, and "a good assortment of fungi for so late in the season" was reported. Leader, G. G. Nearing.

October 21. Princeton Junction, N. J. This trip was made a common meeting ground for bird and plant enthusiasts. The walk of about 8 miles included Grovers Pond, Millstone River, Cranberry Brook, Plainsboro Pond, and the intervening upland. No lists were reported but botanical comment included the contrasting of the wooded strip around the two ponds and the finding of some plants more common in the pine barrens such as post oak, shingle oak, magnolia, sheep laurel, mountain laurel, a variety of blueberries, and bushy beard grass. A colony of stink-horn fungi attracted considerable attention. Leader, Charles H. Rogers. Attendance 43.

October 28. Long Mountain, Palisades Interstate Park, N. Y. The New York-New Jersey Trail Conference observed its 25th anniversary with a program at the Administration Building, a pilgrimage to the memorial to Raymond H. Torrey, and a hike back to Bear Mountain Station via Popolopen Torne. The Torrey Botanical Club contributed at least 7 to the probably 200 people participating in one part or another of the program. Hike leader, William Burton.

November 4. New Brunswick, N. J. Dr. M. A. Chrysler, Emeritus Professor of Botany at Rutgers University, displayed and discoursed upon the complete collection of Cycad genera represented in the University conservatories. Many other plants of interest were shown in the hour devoted to this study. A circular walk of some seven miles included old fields, stream bank, oak woods, lowland forest, and the scrubby growth of what may be called "pine barrens islands" in Middlesex County. The promised *Lygodium palmatum* was produced. One of nature's methods in making a hill was examined. No plant lists were turned in but a good number of fungi and lichens were recorded by those interested. The fruit of a well loaded persimmon tree was enjoyed, also apples and pears. Thirty-three species of birds were observed. Some flocks of blackbirds, estimated to total 7,000 were seen heading for the Raritan Marshes where these birds congregate in tremendous numbers at this season. Leaders, John W. Shive and John A. Small. Attendance about 30 from Torrey Botanical Club and 20 from Woodland Trail Walkers.

NEWS NOTES

Research Corporation, of New York, a non-profit organization devoted to advancing research and technology by use of revenues from inventions assigned to it by public-spirited inventors, expects to spend $2,500,000 during the next 5 years in grants-in-aid of postwar research in chemistry, physics, mathematics, and their applications. Between 100 and 200 grants of $2,500 to $5,000 annually are to be made to foster the continuation of research in collegiate institutions by men who have been active in war research. These men returning to academic positions may apply for aid. The grants are to be made to the institutions for the purchase of needed equipment and for the employment of assistants. The applications will be judged upon the scientific ability of the applicant, the merit of his project, and the suitability of his institution for such research. But consideration will be given to the contribution which the grant promises to make to the needs and cultural future of the institution. One object of the grants is to aid in maintaining or bettering the standards of instruction in the schools. Applications should be sent to: Research Corporation, 405 Lexington Avenue, New York 17, N. Y.

Word has been received of the death of Dr. John C. Merriam in Oakland, Calif., on October 30th at the age of 76. He had been Professor of Paleontology for many years at the University of California, and Dean of the Faculties in 1920. From that year until 1938 he was President of the Carnegie Institute of Washington. He was a founder, and for 24 years, President of the Save-the-Redwoods League. He directed the early excavations and research at the La Brea Pits, Los Angeles, where fossil remains of animals and birds were found. In recent years he had been working on a philosophical treatment of the John Day Basin in Oregon and its influence on human thought. In many of his writings he tried to interpret science for the general reader, especially in regard to the influence of science on the appreciation of nature.

This is the last separate issue of TORREYA. The result of the poll of the membership, taken last spring regarding the publications of the Club, was 177 for combining the *Bulletin* and TORREYA and 35 for separate publication. Acconrdingly plans have been made, beginning with the January issue of the *Bulletin,* to include material formerly published in TORREYA. Short articles of scientific interest will be included in the regular section of the *Bulletin.* There will be a section entitled "Torreya" which will include brief botanical notes, especially those of more local interest, book reviews, field trips, proceedings of the Club, and news notes. The present editor will continue to receive material for this section. Other material should be sent to Dr. H. W. Rickett, The New York Botanical Garden, New York 58, N. Y.

INDEX TO VOLUME 45

Abelia chinensis, 87; *grandiflora*, 87
Abies balsamea, 13, 117, 118; *fraseri*, 117, 118
Acalypha rhomboidea, 45; *virginica*, 45, 83
Acer, Negundo, 67; *pennsylvanicum*, 67; *pseudoplatanus*, 47; *rubrum*, 67; *saccharium*, 67; *saccharum*, 67; *spicatum*, 47
Acetosella vulgaris, 44
Actaea rubra, 61, 65
Adiantum pedatum, 42
Agalinus paupercula, 50; *purpurea*, 131
Agaricus arvensis var. *purpurescens*, 39; *campestris*, 38; var. *exannulatus*, 39
Agrostemma githago, 107
Agrostis hiemalis, 91
Albizzia julibrissin, 84, 107
Alesia diptera, 126
Alkaloid production, some aspects of, in *Cinchona*, abstract, 29
Allionia, 128, 130; *nyetaginea*, 23
Alnus alnobetula, 47; *incana*, 47, 67; *rugosa*, 67
Alopecurus pratensis, 67
Alsine longifolia, 44
Alternation of generations and classification with special reference to the teaching of elementary botany, 1
Althea rosea, 83
Amanita gemmata, 128; *muscaria*, 39; *pantherina*, 24; *phalloides*, 39
Amanitopsis strangulata, 39
Ambrina ambrosioides, 45, 82
Ambrosia elatior, 49, 87
Amelanchier arborea, 66; *intermedia*, 66; *laevis*, 46, 66; *sanguinea*, 66
Amianthium muscaetoxicum, 127, 128
Amorpha fruticosa, 22, 108, 127
Ampelopsis aconitifolia, 85
Amphicarpa bracteata, 46; *monoica*, 46
Anchistea virginica, 42
Andropogon glomeratus, 91
Anemone canadensis, 43; *cylindrica*, 43; *quinquefolia*, 65
Anemonella thalictroides, 43, 65
Angelica atropurpurea, 47
Antennaria canadensis, 67; *fallax*, 67; *neglecta*, 67; *neodioica*, 67; *Plantaginifolia*, 67, 87, 108
Anthopogon procerus, 50
Anthoxanthum odoratum, 52
Apocynum androsaemifolium, 48
Arabidopsis thaliana, 81, 107
Arabis laevigata, 43; *pycnocarpa*, 43
Arenaria serpyllifolia, 66
Arisaema Dracontium, 22; *triphyllum*, 67
Aristida dichotoma, 109
Aronia arbutifolia, 84, 107; *floribunda*, 46; *prunifolia*, 46
Arsenococcus ligustrinus, 48
Artemesia, 93
Arundinaria japonica, 91
Arundo donax, 91
Asarum, 100; *canadense*, 67
Asclepias exaltata, 48, 86; *incarnata*, 48; *phytolaccoides*, 86; *syriaca*, 48; *tuberosa*, 86
Asplenium cryptolepis, 61: *Ruta-muraria*, 61; *trichomanes*, 42
Aster depauperatus, 61; *dumosus*, 108; *ericoides*, 87; *exilis*, 87; *gracilis*, 87; *laevis*, 49; *macrophyllus*, 101; *novi-belgii*, 87; *puniceus*, 87; *ramosissimus*, 49, 87
Atriplex hastata, 131
AVERY, GEORGE S., JR. Hormonal aspects of plant life, lecture, 62
Azalea prinophylla, 48

Baccharis halimifolia, 87
Balsam fir, an abnormal, 13
Baptisia tinctoria, 46, 108
Barbarea vulgaris, 66
Bartonia, 36
BEETLE, ALAN A. Kennedy & Heller (1905-1913), 93
Behavior of the flowers of the aguacatillo (*Persea caerulea*), 110
Bellis perennis, 67
Berberis Thunbergii, 65; *vulgaris*, 65, 107
Beta vulgaris var. *cicla*, 45
Betula, 117; *lenta*, 47; *lutea*, 23; *papyrifera*, 67; *populifolia*, 67
Bicuculla cucullaria, 100
Bidens bipinnata, 88, 108; *connata*, 88; *frondosa*, 88; *trichosperma*, 88
Bignonia radicans, 90
Bilderdykia scandens, 44
Blephariglottis albiflora, 91; *psycodes*, 51
Boletinus porosus, 39
Boletus affinis, 39; var. *maculosus*, 39; *castaneus*, 39; *felleus*, 39; *Frostii*, 39; *luridus*, 39; *pallidus*, 39; *parasiticus*, 39; *Peckii*, 39; *purpureus*, 39; *Russelli*, 39; *speciosus*, 39; *subglabripes*, 39; *subtomentosus*, 39; *vermiculosus*, 39; var. *Spraguei*, 39
Boltonia asteroides, 61
Bomb damage to botanical material in England, 96
Books Reviewed:
BAXTER, D. V. Pathology in forest practice, 15
CAIN, S. A. Foundations of plant geography, 17

Books Reviewed—*continued*
Jones, G. N. Flora of Illinois, 122
Muenscher, W. C. Aquatic plants of the United States, 119
Seton, E. T. The arctic prairies, 53
Webber, I. E. Travelers All, 53
Borago officinalis, 89
Botanist leaves Hawaii, 72
Botrychium lanceolatum, 25; *simplex*, 25; var. *tenebrosum*, 24
Bovista plumbea, 40
Brassica kaber, 43; *napus*, 81
Breweria Pickeringii, 129
Bromus commutatus, 109
Broussonetia papyrifera, 26, 85
Buell, Murray F. Late Pleistocene forests of southeastern North Carolina, 117
Buellia parasema, 80

Cakile edentula, 61
Calamagrostis cinnoides, 92
Calla palustris, 61
Caltha palustris, 65
Campanula rotundifolia, 50
Campe barbarea, 81
Camptosorus rhizophyllus, 23
Camsis radicans, 90, 109
Cantharellus cibarius var. *simplex*, 39
Capsella bursa-pastoris, 43, 66
Cardamine bulbosa, 66; *pensylvania*, 66; *pratensis*, 66; var. *palustris*, 43
Carex, 22; *anceps*, 67; *arctata*, 67; *artitecta*, 67; *blanda*, 67; *bromoides*, 67; communis, 67; *cristatella*, 52; *Deweyana*, 67; *hirtifolia*, 67; *laxiculmis*, 67; *lurida*, 109; *pedunculata*, 67; *pennsylvanica*, 67; *plantaginea*, 67; *platyphylla*, 52, 67; *prasina*, 67; *scabrata*, 67; *stipata*, 67; *stricta*, 52, 125; *umbellata*, 67; *versicaria*, 52
Carpinus caroliniana, 67
Carya pecan, 85
Castanea dentata, 47
Castilleja, 93, 94
Caulophyllum thallictroides, 65
Ceanothus americanus, 47; *carolinensis*, 85; *pensylvanicus*, 85
Celosia argentea, 82; var. *pyramidalis*, 82
Cenchrus tribuloides, 92
Centaurea cyanus, 49, 131; *maculosa*, 49
Centaurium pulchellum, 89
Cerastium arvense var. *villosum*, 61; *viscosum*, 82; *vulgatum*, 66
Cespedezia, 69
Chamaecrista fasciculata, 84; *nictitans*, 46, 107
Chamaedaphne calyculata, 48
Chamaenerion spicatum, 45
Chamaepericlymenum canadense, 47
Chamaesyce maculata, 83; *polygonifolia*, 83; *preslii*, 83
Cheilanthes lanosa, 23, 61
Chelidonium majus, 66
Chelone glabra, 50
Cheney, Ralph H. The pineapple industry, lecture, 59
Chenopodium album, 82; *ambrosioides*, 82; *rubrum*, 82
Cherries, Origin and development of flowering, abstract, 64
Chionanthus virginica, 86
Chondrilla juncea, 108
Chrysanthemum leucanthemum, 88
Chrysopsis mariana, 88, 108
Chrysosplenium americanum, 66
Cicuta maculata, 47
Cinchona, Some aspects of alkaloid production in, abstract, 29
Cirsium discolor, 108
Citrullus vulgaris, 83
Cladonia multiformis, 25
Clausen, Robert T. Early flowering of plants in 1945, 65
Clavaria cinerea, 39; *corraloides*, 39; *fusiformis*, 39
Clavatia lilicina, 40
Claytonia caroliniana, 66; *virginica*, 44, 66, 100
Clematis paniculata, 107; *virginiana*, 43
Clethra alnifolia, 86
Clintonia borealis, 51, 61
Clitocybe adirondakensis, 39; *illudens*, 25; *laccata*, 40; *prunulus*, 40
Collybia acervata, 40; *lacera*, 40; *platyphylla*, 40; *strictipes*, 40
Coluber constrictor, 127
Colus Javinicus, 128
Comandra umbellata, 67
Commelina communis, 91
Conoclinium coelestinum, 88
Convolvulus repens, 89; *spithamaeus*, 89
Cook, David B. An abnormal balsam fir, 13
Coptis groenlandica, 61, 81; *trifolia*, 125; subsp. *groenlandica*, 65
Corallorrhiza trifida, 52
Coreopsis tinctoria, 49
Cornus canadensis, 61
Cortinarius cylindripes, 40; *cinnamoneus*, 40
Corydalis flavula, 23
Corylus cornuta, 47, 67
Cosmos bipinnatus, 49
Crataegus, 84; *filipes*, 66; *macrosperma*, 66; *pruinosa*, 66
Crocanthemum majus, 83
Crotonopsis linearis, 129
Cucumis melo, 83
Cucurbita pepo, 83
Cuphea petiolata, 82
Cuscuta campestris, 90

Cyanococcus vacillans, 48, 86
Cyclomyces Greenii, 39
Cyperus esculentus, 91; *retrorsus*, 91; *strigosus*, 52, 91, 109; *torreyi*, 91
Cypripedium parviflorum, 67
Cystopteris fragilis, 23
Cytisus scoparius, 108

Dactylis glomerata, 109
Daedalea confragosa Klotzchii, 39; *confragrosa* var. *rubescens*, 39
Daldinia concentrica, 38
Daphne Mezereum, 67
Dasiphora fruticosa, 45
Dasystephana andrewsii, 50; *saponaria*, 89
Datura stramonium var. *tatula*, 89
Davis, William T., 32
Dawson, Ray F. Some aspects of alkaloid production in *Cinchona*, lecture, 29
Decachaena baccata, 86, 108
Degener, Otto. A botanist leaves Hawaii, 72; Plant life and customs of the Hawaiian Islands, lecture, 63
Delaware flora, 106
Delphinium ajacis, 81
Denslow, H. M., Memorial, 27, 28
Dentaria diphylla, 66; *laciniata*, 66
Desmodium dillenii, 84; *laevigatum*, 84; *marilandicum*, 84; *paniculatum*, 84; *rigidum*, 84
Dianthus barbatus, 44
Dicentra canadensis, 66; *cucullaria*, 66
Diervilla lonicera, 49
Diodella teres, 108
Dioscorea paniculata, 51
Dirca palustris, 67
Distichlis spicata, 92
Ditremexa marilandica, 84
Draba verna, 66
Dryopteris intermedia, 42; *marginalis*, 42; *simulata*, 127
Duchesnea indica, 66
Dwyer, John D. The taxonomy of the genus *Krukoviella*, 69

Early flowering of plants in 1945, 65
Eastwood, Alice, Semi-centennial publications, 32
Echinochloa crusgalli, 52, 92; *pungens*, 52; *walteri*, 92
Ecology of the New York area, abstract, 64
Eleocharis capitata, 52; var. *borealis*, 52
Elephantopus nudatus, 88
Entoloma cuspidatum, 40
Epigaea repens, 48, 66
Equisetum arvense, 65; *hyemale* var. *affine*, 65; *sylvaticum*, 65; *variegatum*, 65
Eragrostis capillaris, 109
Erianthus contortus, 92; *giganteus*, 130; *saccharoides*, 92
Erica parviflora, 86
Erigeron pulchelus, 49
Eriocaulon Parkeri, 26; *septangulare*, 51
Erodium cicutarium, 82, 107
Eryngium aquaticum, 86
Erysimum officinale var. *leiocarpum*, 43
Erythronium americanum, 67
Eubotrys racemosa, 86
Eucommia, 21
Euonymus, 26; *japonica*, 85
Eupatorium aromaticum, 88; *hyssopifolium*, 25, 88; *leucolepis*, 88, 129; *perfoliatum*, 49; *purpureum*, 88; *resinosum*, 26, 129; *rotundifolium*, 88; *serotinum*, 88; *verbenaefolium*, 108
Euphorbia cyparissias, 23, 66; *esula*, 83
Euthamia caroliniana, 88; *graminifolia*, 88; *tenuifolia*, 88

Fagopyrum esculentum, 44
Fagus grandifolia, 47
Festuca elatior, 109; *octoflora*, 23
Ficus carica, 85
Field Trips, leaders:
Abbott, Mrs. Laura W., 126
Anderson, Mrs. G. E., 126
Blatchley, Myrtice A., 56
Burton, William, 132
Condon, Nellie Louise, 26, 126
Dix, W. L., 125
Dodge, B. O., 25
Dole, W. Herbert, 21, 24, 128
Doney, Charles, 21
Dotson, Henrietta, 22, 127
Ericson, Charles, 24, 25, 128, 131
Fables, David, 21, 57 132
Fogg, John M., Jr., 125
Friend, Eleanor, 24, 128
Gordon, H. B., 131
Gordon, R. B., 128
Graves, A. H., 26
Gundersen, Alfred, 126, 131
Hagelstein, Robert, 26, 131
Hallock, E. D., 26, 131
Hand, Louis, 23, 26, 126, 127, 129, 130
Hass, Theodor, 128, 130
Hawley, James, 126
Heyer, Miss, 21
Holtzoff, Mrs. Mary, 23, 26, 128, 130
Husk, W. M., 21
Johnson, Julius, 21
Kalmykow, Alexandra, 22, 127
Koster, Hollis, 129, 130
LaDow, Arthur, 125, 128, 130
Levine, Michael, 23, 127
Lewis, F. R., 21, 24, 25 27, 126, 128, 129, 131
Mohr, Charles E., 125, 130
Monachino, Joseph, 24, 129
Murphy, James, 22, 24, 27
Nearing, G. G., 23-25, 57, 125, 128-132

Field Trips, Leaders—*continued*
Petersen, Grace, 22, 26, 127
Redjives, Mr. & Mrs., 131
Rispaud, Joseph, 26, 131
Rissanen, William, 24
Rogers, Charles H., 132
Rulison, Mr. & Mrs. Robert, 126
Rusk, Hester, 26
Seaver, Fred J., 128
Shive, John W., 132
Small, John A., 27, 127, 132
Snedigar, Robert, 56
Svenson, H. K., 23
Todd, Harold, 21
Tolstoouhov, Alexander V., 25, 129
Weig, Elsie, 127
Wenman, Lois, 127
Wherry, E. T., 128
Wiley, Farida, 26, 126, 131
Field Trips, Locations:
Albion, N. J., 125
American Museum of Natural History, 56
Andover, N. J., 23
Arden, N. Y., 24, 125, 132
Atlantic Beach, L. I., 127
Audubon Nature Center, Conn., 22, 126
Barrett Park Zoo, S. I., 26
Berlin, N. J., 23
Bound Brook, N. J., 27
Boyce Thompson Institute, 56
Branchville, 21
Brooklyn Botanic Garden, 2, 26, 131
Camp Thendara, 126
Douglaston, L. I., 131
Egg Harbor City, N. J., 129
Englewood Cliffs, N. J., 26, 130
Far Rockaway, 22
Forked River, 23, 130
Fort Lee, N. J., 131
Haskell, N. J., 24, 25, 126, 128, 129, 131
Hopewell, N. J., 25
Interstate Park, N. Y., 129, 132
Jockey Hollow, Morristown, N. J., 127
Lawrence Harbor, N. J., 127
McClean Woods, N. Y., 26
Medford Lakes, N. J., 127
Midvale, N. J., 21, 130
Mineola, L. I., 26, 131
Montefiore Hospital, 23, 127
Morris Arboretum, Philadelphia, 126
Mt. Peter, N. Y., 128
Mt. Vernon, N. Y., 23, 128
Nepera Park, Yonkers, 24, 128
New Brunswick, N. J., 132
N. J. College for Women, 57
N. Y. Botanical Garden, 25, 128
Old Mill Road, Bronx, 26
Palisades, 27, 126
Pine Barrens, N. J., 26, 127
Point Pleasant, N. J., 131
Field Trips, Locations—*continued*
Princeton Junction, N. J., 132
Prospect Park, Brooklyn, 126
Richmond, S. I., 26
Richmond Valley, S. I., 25
Schunemunk Mt., N. Y., 25, 129
Silver Lake, White Plains, 126
Sinac, N. J., 129
Sloatsburg, 25, 129
South Beach, S. I., 130
Southfields, N. J., 25, 27, 129
South Mountain Reservation, N. J., 24
Springfield, N. J., 130
Spring Lake, N. J., 56
Surprise Lake, N. J., 129
Tohickon Creek, Pa., 22, 127
Towaco, N. J., 131
Tuxedo, N. Y., 24, 25
Van Cortlandt Park, 24
Ward's Point, S. I., 23, 128, 130
Watchung Reservation, 126
West Orange, N. J., 24, 128
Woodlands, Westchester Co., 22, 127
Filipendula ulmaria, 45
Fissipes acaulis, 52, 91
Flammula spumosa, 40
Fleshy fungi of Fishers Island, 38
Fogg, John M., Jr. Studies on the Pennsylvania flora, lecture, 60
Fragaria vesca, 66; *virginiana*, 66, 84
Fraxinus americana, 48; *pennsylvanica*, 66
Froelichia floridana, 82
Fucus vesiculosus, 99
Fumaria officinalis, 81

Galarhoeus cyparissias, 45; *esula*, 83; *helioscopia*, 83
Galera tenera, 40
Galium aparine, 67; *tinctorium*, 48
Gaultheria procumbens, 48
Gaylussacia baccata, 86
Geaster hygrometricus, 40
Geoglossum farlowi, 38; *hirsutum*, 38; *peckianum*, 38
Geranium maculatum, 45, 66
Gerardia paupercula, 50; *purpurea*, 90; *setacea*, 90
Geum aleppicum var. *strictum*, 45; *canadense*, 46
Glycosides, Induced formation of, in plants, abstract, 58
Gnaphalium obtusifolium, 88
Godoya disticha, 69-71
Goodwin, R. H. Some effects of light upon the growth and differentiation of the oat seedling, lecture, 28

Habenaria cristata, 129
Hagelstein, Robert, 26, 131
Hanmer, Charles C. A list of fleshy fungi of Fishers Island, N. Y., 38

HARPER, ROLAND M. Some 19th century recollections of New York and its botanical activities, 97
Hawaii, A botanist leaves, 72
Hedeoma pulegioides, 90
Hedera helix var. *arborescens*, 86
Helianthus tuberosus, 88
Heller, A. A., 93-96
Helonias bullata, 127
Hepatica acutiloba, 65; *americana*, 65
Hesperis matronalis, 66
Heterotheca subaxillaris, 109
Hibiscus syriacus, 83, 107
Hicoria pecan, 85
Hieracium aurantiacum, 49; *gronovii*, 87; *marianum*, 87; *pratense*, 49
Holcus sorghum var. *drummondii*, 92
Hormonal aspects of plant life, abstract, 62
Houstonia caerulea, 67, 86
Hudsonia ericoides, 125
Hydnum concrescens, 39; *scrobiculatum*, 39; *zonatum*, 39
Hydrastis canadensis, 65
Hygrophorus ceraceus, 40; *chlorophanus*, 40; *conicus*, 40; *lacteus*, 40; *marginatus*, 40; *nitidus*, 40; *virgineus*, 40
Hyla andersonii, 127
Hypericum canadense, 45; *Drummondii*, 36; *gentianoides*, 36, 37; a leafy form of, 36; *perforatum*, 45
Hypholoma appendiculatum, 40
Hypoxis hirsuta, 67

Ibicella lutea, 90
Ilex glabra, 85; *laevigata*, 26; *opaca*, 61, 85; *verticillata*, 26
Illinois flora, Review, 122
Impatiens balsamina, 82; *roylei*, 45
Ionactis linariifolius, 49
Ipomea batatas, 89; *lacunosa*, 89; *pandurata*, 25
Iris versicolor, 51
Island Beach, 33-35; Letters, 62, 63; Resolution, 59
Isoetes Braunii, 26
Itea virginica, 23
Iva oraria, 87

Jeffersonia diphylla, 65
JOHANSON, ALFHILD, E. A new mycelioid Chytrid: *Myceliochytrium fulgens* gen. nov. et sp. nov., 104

KARLING, J. S. Unusual Chytridiaceous fungi from Brazil, lecture, 27
Kennedy and Heller (1905-1913), 93
Kneiffia perennis, 83
Koellia flexuosa, 90
Kosteletzkya virginica, 83
Krigia virginica, 87, 108
Krukoviella disticha, 69-71; *scandens*, 69, 71, 72; The taxonomy of the genus, 69

Laccaria amethystina, 25
Lactarius aquifluus, 40; *helva*, 40; *involutus*, 40; *lignyotus*, 40; *luteolus*, 40; *piperatus*, 40; *serifluus*, 40; *trivialis*, 40; *vellereus*, 40; *volemus*, 40
Lactuca sativa var. *crispa*, 49
Lagerstroemia indica, 82
Lamium amplexicaule, 66; *purpureum*, 66
Lathyrus maritimus, 61
Lecanora pallida, 80
Lechea racemulosa, 83
Leonurus cardiaca, 51
Lepidium campestre, 66
Lepiota naucinoides, 40; *procera*, 40
Leptamnium virginianum, 131
Lespedeza capitata, 84; *cuneata*, 84; *intermedia* f. *hahnii*, 108; *procumbens*, 108; *repens*, 84, 108; *stipulacea*, 108; *stuvei*, 84; *virginica*, 108
Leucanthemum vulgare, 88
Leucothoë catesbaei, 86; *racemosa*, 86
Levisticum officinale, 47
Light, Some effects of, upon the growth and differentiation of the oat seedling, abstract, 28
Ligustrum amurense, 86
Lilium canadense, 51; *philadelphicum*, 51; *superbum*, 91
Limonium carolinianum, 89, 131
Linaria canadensis, 90, 109
Lindera benzoin, 65
Liquidambar styraciflua, 61
Lithospermum arvense, 66, 89, 109
LITTLEFIELD, E. W. Review, 15
Lobelia glandulosa, 89; *puberula*, 89; *spicata*, 50
Lonicera canadensis, 67, 87; *dioica*, 49; *fragrantissima*, 87; *tatarica*, 67
Lorinseria areolata, 42
Lupinus, 93-96; *bicolor*, 94; *laxiflorus*, 94; *micranthus*, 94; *perennis*, 46, 85, 108, 125
Luzula acuminata, 67; *campestris*, 67
Lycoperdon cruciatum, 40; *umbrinum*, 40
Lycopodium clavatum, 43; *flabelliforme*, 43; *obscurum*, 65; var. *dendroideum*, 43
Lycopus sessilifolius, 26
Lysimachia quadrifolia, 50; *terrestris*, 50
Lythrum alatum, 128; *hyssopifolia*, 128

Magnolia virginiana, 127
Malus angustifolia, 84
Malva neglecta, 45, 66
Marasmius oreades, 40; *scorodonius*, 40
Marrubium vulgare, 90
Marshallia grandiflora, 61
Maryland flora, 79
MASON, HERBERT L. Review, 17
Massachusetts flora, 41

Matricaria suaveolens, 49
McKenna, P. J. The relation of botany to horticulture, lecture, 30
Medicago lupulina, 46, 67
Meibomia dillenii, 84; *marylandica*, 84; *paniculata*, 84; *rigida*, 84
Melampyrum lineare var. *latifolium*, 50
Melandrium, Localization of the male determining gene in, abstract, 57
Melilotus alba, 85
Mentha citrata, 24; *piperita*, 90
Menziesia pilosa, 61, 86
Merriam, John C., 133
Mertensia virginica, 66
Merulius lacrymans, 39
Micranthes micranthidifolia, 81
Mikania scandens, 88, 131
Miller, Lawrence P. Induced formation of glycosides in plants, lecture, 58
Mitella diphylla, 66
Moldenke, Alma L. Review, 53
Moldenke, Harold N. A contribution to our knowledge of the wild and cultivated flora of Delaware, 106; of Maryland, 79; of Massachusetts, 41; Reviews, 119, 122
Mollugo verticillata, 44
Monarda fistulosa L. and its two white-flowered forms, 68: *clinopodia*, 68; *didyma*, 51; **fistulosa** var. **typica**, 68; f. *albescens*, 68; var. **mollis**, 68; f. **albiflora**, 68; *mollis*, 68; *punctata*, 90
Monotropa Hypopitys, 129; *uniflora*, 48
Muscari botryoides, 91
Myceliochytrium fulgens, 104, 105
Mycena galericulata, 26
Myosotis sylvatica, 66
Myrica peregrina, 67

Nabalus albus, 87
Najas flexilis, 91
Nectandra, 110
Nepeta hederacea, 66
Nicandra physalodes, 89
Nintooa japonica, 87
Nyssa biflora, 86; *sylvatica*, 85

Odostemon aquifolium, 81
Oenothera muricata, 45
Officers for 1945, 30
Opuntia vulgaris, 127
Origanum vulgare, 51
Orobanche ramosa, 90
Orontium aquaticum, 51
Orthilia secunda, 48
Oryzopsis asperifolia, 67
Osmunda cinnamomea, 42, 80; var. *frondosa*, 42; *claytoniana*, 42, 65
Osmundopteris virginiana, 42
Ostrya virginiana, 67
Oxalis montana 45, 61; *stricta*, 66

Padus virginiana, 46, 107
Panaeolus campanulatus, 40
Panax trifolium, 67
Panicularia grandis, 91
Panicum amarulum, 92; *capillare*, 52; *dichotomiflorum*, 92; *meridionale*, 92; *polyanthes*, 109; *verrucosum*, 92; *virgatum* var. *cubense*, 92
Papyrius payrifera, 85
Parietaria pennsylvanica, 23
Parmelia conspersa, 80; *perforata*, 80
Parnassia caroliniana, 44
Paspalum floridanum var. *glabratum*, 92; *laeve*, 92
Pastinaca sativa, 86; var. *sylvestris*, 48
Pedicularis canadensis, 50, 66
Pennsylvania flora, abstract, 60
Penstemon digitalis, 109; *laevigatus*, 50
Persea caerulea, 110; *Schiedeana*, 110
Persicaria pensylvanica, 82; var. *laevigata*, 82; *punctata*, 82
Petroselinum crispum var. *crispum*, 48
Phacelia, 94
Phaethusa occidentalis, 88
Pharbitis purpurea, 89
Phaseolus limensis var. *limenanus*, 46; *vulgaris* var. *humilis*, 46
Phenianthus sempervirens, 87
Philadelphus coronarius, 45
Phleum pratense, 109
Phlox divaricata, 66; *drummondii*, 89; *subulata*, 66
Phloradendron flavescens, 85
Physalis subglabrata, 89
Physalodes peruvianum, 89
Physostegia virginiana, 109
Phytolacca americana, 82
Pilostaxis lutea, 81
Pineapple industry, abstract, 59
Pinus banksiana, 118; *glabra*, 118; *palustris*, 117; *pungens*, 61; *taeda*, 81, 107
Planchonella disticha, 69-72
Plantago virginica, 89, 109
Pleistocene forests of Southeastern North Carolina, 117
Pluchea camphorata, 88
Poa annua, 67; *pratensis*, 67, 109
Polanisia trachysperma, 24, 128, 130
Polunin, Nicholas, 96
Polycodium stamineum, 86
Polygala paucifolia, 66, 125; *sanguinea*, 81; *viridescens*, 81
Polygonatum pubescens, 67
Polygonella articulata, 131
Polygonum Careyi, 129; *Muhlenbergii*, 22; *virginianum*, 98
Polyporus Berkeleyi, 39; *betulinus*, 39; *cinnabarinus*, 39; *elegans*, 39; *Sprageui*, 39
Polystictus perennis, 39

Populus balsamifera, 65; *canadensis*, 47; *grandidentata*, 65; *tacamahacca*, 46; *tremuloides*, 65; *virginiana*, 47
Potamogeton americanus, 90; *pectinatus*, 91; *perfoliatus*, 91; *pusillus*, 91
Potentilla canadensis, 84; *pumila*, 84
Prenanthes alba, 87
Proceedings of the Club:
Oct. 18, 1944, 27 Feb. 21, 1945, 57
Nov. 15, 1944, 27 Mar. 6, 1945, 58
Dec. 5, 1944, 29 Mar. 21, 1945, 59
Dec. 20, 1944, 29 Apr. 3, 1945, 61
Jan. 9, 1945, 30 Apr. 18, 1945, 62
Jan. 17, 1945, 31 May 2, 1945, 63
Feb. 6, 1945, 57
Prunella vulgaris var. *lanceolata*, 51
Prunus americana, 66; *angustifolia*, 84; *avium*, 66; *depressa*, 22; *domestica*, 66; *pennsylvanica*, 66; *virginiana*, 66
Pteridium latiusculum, 42
Pycnanthemum aristatum, 90; *flexuosum*, 90, 109; *virginianum*, 109
Pyrola elliptica, 48
Pyrus communis, 66; *Malus*, 66

Quamoclit coccinea, 89
Quercus alba, 67; *benderi*, 126; *bicolor*, 85; *borealis* var. *maxima*, 85; *catesbaei*, 117; *falcata*, 85; *ilicifolia*, 47; *imbricaria*, 61; *maxima*, 85; *nigra*, 85; *phellos*, 61, 85; *rubra*, 85

Raimannia humifusa, 83; *laciniata*, 83
Ramolina calicaris, 80
Ranunculus abortivus, 65; *acris*, 43; *hispidus*, 65, 81; *micranthus*, 23; *septendrionalis*, 65
Raphanus sativus, 43
RAUP, HUGH M. Review, 53
Recollections of New York and its botanical activities, 97
REED, GEORGE M. Origin and development of flowering cherries, lecture, 64
Reynoutria sachalinensis, 44
Rhexia aristosa, 129; *mariana*, 83, 107; f. *albiflora*, 83; *nashii*, 83 *virginica*, 107
Rhodendron canadense, 61; *maximum*, 23; *nudiflorum*, 66, 125
Rhus aromatica, 67; *canadensis*, 61; *typhina*, 47
Rhytidanthera, 69
Ribes, 93; *americanum*, 66; *Cynosbati*, 66; *hirtellum*, 66; *odoratum*, 66; *sativum*, 66; *triste*, 66
Ricinus communis, 83
Rubus idaeus var. *aculeatissimus*, 46; *pubescens*, 66
Rumex acetosella, 66
Russula, 38; *compacta*, 40; *virescens*, 40
Rynchospora glomerata, 91

Saccharodendron saccharum, 47
Saccharum officinarum, 92
Sagittaria latifolia, 51
Salicornia europea, 131
Salix alba, 65; *Bebbiana*, 66; *cordata*, 66; *discolor*, 66; *fragilis*, 66; *humilis*, 66; *longifolia*, 22; *tristis*, 25
Salsola kali, 82
Salvia azurea, 90
Sambucus racemosa subsp. *pubens*, 67
Sanguinaria canadensis, 66
Sanicula, 100; *marilandica*, 108
Saponaria officinalis, 44
Sarothra, 36
Sassafras albidum, 65
Saururus cernuus, 107
Saxifraga virginiensis, 67
Schizophyllum commune, 40
Sciadopitys verticillata, 81
Scirpus, 91; *georgianus*, 98; *heterochaetus*, 52
Scleria pauciflora, 128
Scleroderma geaster, 40; *vulgare*, 40
Scrophularia, 100
Scutellaria nervosa, 23
Senecio antennariifolius, 61; *aureus*, 67; *pauperculus* var. *balsamitae*, 49; *tomentosus*, 88; *vulgaris*, 67
Serapias helleborine, 52, 129
Sericocarpus linifolius, 88
Setaria faberi, 92
Shepherdia canadensis, 67
SHERFF, EARL EDWARD. *Monarda fistulosa* L. and its two white-flowered forms, 68
SHIVE, JOHN W. The iron manganese relation in plants, lecture, 29
Sibbaldiopsis tridentata, 46
Silene caroliniana, 81; *cucubalus*, 44; *latifolia*, 44
Sinowilsonia, 21
Sisymbrium, 100; *officinale* var. *leiocarpum*, 43
Sisyrinchium arenicola, 91; *mucronatum*, 91
SKUTCH, ALEXANDER F. The behavior of the flowers of the aguacatillo (*Persea caerula*), 110
SMALL, JOHN A. Island Beach, 33
Smilacina racemosa, 51
Smilax laurifolia, 26; *Walteri* 26, 129
Soja max, 46, 85
Solanum carolinense, 89; *nigrum*, 89
Solidago altissima, 49, 88; *bicolor*, 49, 88; *hirsutissima*, 88; *juncea*, 49; *nemoralis*, 50, 88; *odora*, 25; *rugosa*, 88; *serotina*, 50; *squarrosa*, 61; *stricta*, 129
Sorghum halepense, 92; *vulgare* var. *drummondii*, 92
Spartina alterniflora, 92
Spinacia, cytology of tapetal cells in, 31; *oleracea*, 82

Spiraea latifolia, 46; *tomentosa,* 46, 84
Spiranthes cernua, 26
Sporobolus vaginaeflorus, 109
Stachys palustris, 51
Staphylea trifolia, 67
Steironema ciliatum, 50
Stellaria media, 66; *pubera,* 66
Stomoisia cornuta, 122
Stropharia semiglobata, 26
Strophostyles helvola, 25, 108, 131; *umbellata,* 85
Svenson, H. K. A leafy form of *Hypericum gentianoides,* 36; Ecology of the New York area, lecture, 64
Symphoricarpus orbiculatus, 87; *vulgaris,* 87
Symplocarpus foetidus, 67
Syndesmon thalictroides, 43

Talinum teretifolium, 61
Tanacetum vulgare, 25
Taraxacum officinale, 67
Taxodium distichum, 81
Taxus baccata var. *canadensis,* 65; *canadensis,* 43
Teucrium occidentale, 51
Thalictrum dioicum, 43, 65; *polygamum,* 43
Thelephora multipartita, 38; *palmata,* 38
Thlaspi arvense, 66
Tiarella cordifolia, 67
Tithymalus helioscopia, 83
Tradescantia virginiana, 23
Tragopogon pratensis, 23, 49
Trapa natans, 122
Tremella intumescens, 38
Tremellodendron candidum, 38; *merismatoides,* 38
Tremellodon gelatinosum, 129
Triadenum virginicum, 83
Triclisperma paucifolia, 44
Trifolium, 93-96; *agrarium,* 46; *arvense,* 108; *incarnatum,* 85, 108; *pratense,* 46; *repens,* 67
Trillium erectum, 51, 67; *grandiflorum,* 67; *nivale,* 61; *sessile,* 61; *undulatum,* 61, 67
Triodia flava, 92, 109
Trollius laxus, 65
Tussilago Farfara, 67

Ulmus americana, 47, 66; *fulva,* 66
Uniola laxa, 92
Usnea barbata, 80; *florida,* 80
Ustilago zeae, 42
Utricularia inflata var. *minor,* 127
Uvularia grandiflora, 67; *perfoliata,* 51, 67; *sessilifolia,* 67

Vaccinium angustifolium, 66, 86, *corymbosum,* 66, 125; *vacillans,* 48, 86
Vancouveria hexandra, 43
Veratrum viride, 51
Verbascum blattaria f. *albiflorum,* 109; *phlomoides,* 50
Verbena hastata, 50, 90; f. *albiflora,* 50; *officinalis,* 90; *peruviana,* 90; *urticifolia,* 50, 90
Veronica agrestis, 90; *arvensis,* 66; *didyma,* 66; *filiformis,* 66; *peregrina,* 66; *serpyllifolia,* 66
Veronicastrum virginicum, 50
Viburnum alnifolium, 67; *lantanoides,* 49; *nudum,* 26; *prunifolium,* 87, 108; *trilobum,* 49
Vicia caroliniana, 67; *cracca,* 108; *sativa,* 85
Viola affinis, 44; *arvensis,* 66; *blanda,* 44, 66; *canadensis,* 66; *conspersa,* 44, 66; *cucullata,* 66; *fimbriatula,* 57, 66; *incognita,* 66; *lanceolata,* 57; *odorata,* 66; var. *alba,* 81; *pallens,* 66; *palmata,* 66; *papilionacea,* 44; *pedata* var. *linearriloba,* 44; *pensylvanica,* 66; *primulifolia,* 57, 81; *pubescens,* 66; *renifolia,* 66; *rostrata,* 66; *rotundifolia,* 66; *sagittata,* 56; *Selkirkii,* 66; *septentrionalis,* 66; *sororia,* 56, 66; *striata,* 66
Viorna urnigera, 81
Volvaria bombycina, 40

Wahl, Herbert A. Alternation of generations and classification with special reference to the teaching of elementary botany, 1
Waldsteinia fragarioides, 66
Warmke, H. E. Studies on localization of the male gene in *Melandrium,* lecture, 57
Weigela floribunda, 87
Whetzel, H. H., 32
Witkus, Eleanor, R. Cytology of tapetal cells in *Spinacia,* lecture, 31
Woodsia obtusa, 23

Xanthium echinatum, 87
Xanthoxalis repens, 82; *stricta,* 82
Xylosteon canadense, 87; *fragrantissimum,* 87

Zanthoxylum americanum, 66
Zinnia haageana, 50
Zizia aurea, 67

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